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VOLUME 14 NUMBER 1 SEPTEMBER 1945

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Leo C. Massopust, Editor

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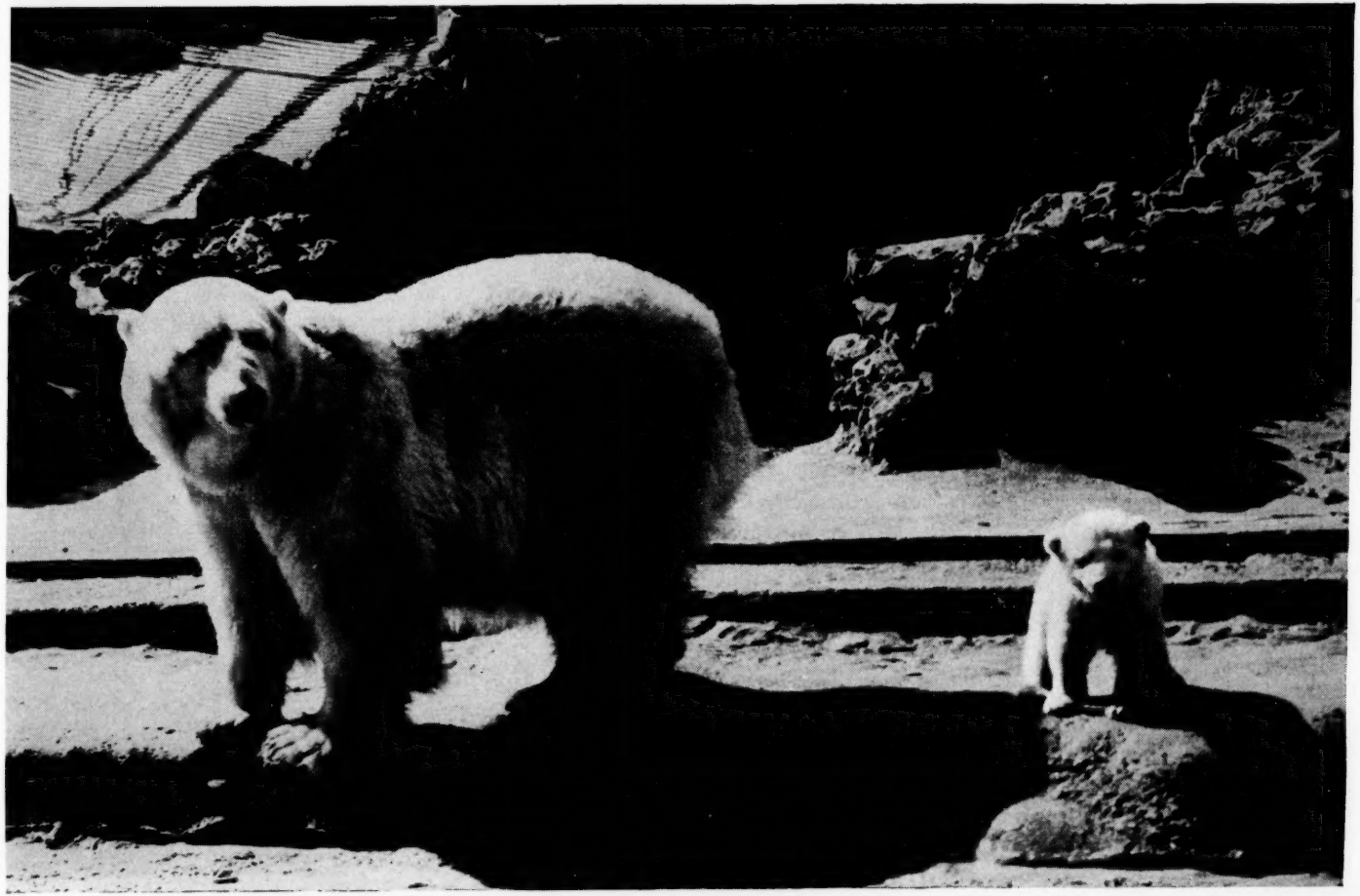


Ray Miess

Anterior Segment Eye Photography in Kodachrome

B. Copeland* and J. D. Brubaker†

Apparatus

MAKING eye photographs of the anterior segment, in color, showing typical lesions such as cataract, cysts, ulcers, and pinguecula, involves some special problems in photography. Figure 1 illustrates the apparatus used. It consists of a stand to hold the ground-glass focusing type camera and lights. The lights are adjustable laterally and vertically. The camera height is independently adjustable. After the lights and camera are adjusted to the proper relative height, the whole assembly is adjustable for use at different heights above the table top. A chin rest for the patient should be used. The two lamps are operated at low voltage through a resistor for focusing.

A resistor is preferable to a transformer for reducing the voltage, since the apparatus can be used on either alternating or direct current interchangeably. A condenser is necessary on direct current to prevent arcing at the switch contacts. A snap-action (micro) switch is synchronized with the camera release button so that the resistor is short-circuited a moment before the picture is taken.

Discussion

The special problems encountered in anterior segment eye photography are as follows: (1) To place the reflected image of the light source (known as the *corneal reflex*) in a position where it does not cover any important area of the lesion photographed, and to make the reflex as small as possible. (2) To take the picture at a relatively

* Barnett Optical Laboratories, 1218 Pratt Blvd., Chicago 26, Illinois.
† Design and Research Engineer, 805 Greenleaf Street, Evanston, Illinois. Received for publication August 1, 1945.

Legend for Frontispiece

Sultana II and Cub Cirius. Cub born November 29, 1944. The only third generation polar bear cub born in captivity in the world.

Sultana, age 33, Sultana II, age 17, and Cub Cirius, are all present residents of the Washington Park Zoo, Milwaukee, Wisconsin.

Technical data: 3¼ x 4¼ Graflex. Cooke lens. Ansco Isopan film. Printed on Eastman Illustration Special.

fast shutter speed to avoid the *reflex action of the eyelid to bright light.* (3) To arrange apparatus for taking pictures at *nearly life-size (1 to 1 ratio)* which are in *critically sharp focus.* (4) To provide means so that the *light intensity is the same for each exposure,* so that *color pictures* can be made at any time, with assurance that each picture will be properly exposed within the narrow limits required by color film. The apparatus shown in figure 1 was designed with these special problems in mind. A detailed discussion under each of the four headings will be made to show the methods used.

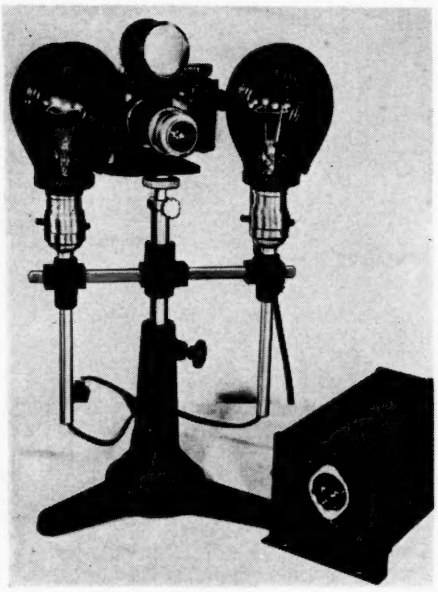


Figure 1

(1) *Corneal Reflex.* It is obvious that the convex surface of the eye will reflect an image of the light source, and this image will appear in part of the picture area. The proper placement of this unavoidable image is not difficult except in cases where the lesion is directly on the cornea. It is desirable to reduce the area of this reflected image (corneal reflex) to the smallest possible size, since it detracts from the appearance of the picture, even when it occupies an unimportant area of the field. The reflex image appears pure white, and of course severely overexposes the film within the area covered by it, figure 2-a, 2-b, 2-c.

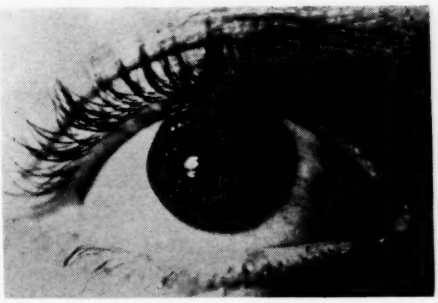
The size of the corneal reflex can be reduced by placing the lamps at a greater distance, but to obtain adequate light, the lamps must be close to the photographic field. Thus the problem becomes one of choosing a small size light source of high intrinsic brilliance. Lamps with a clear glass bulb should be used.[1] Ordinary projection type lamps can be operated at 30 to 40 per cent above normal voltage for brief intervals to obtain approximately the correct color-temperature for type A Kodachrome (3450°K). Eastman CC-4 color-correcting filters can be used to raise the color temperature of lamps operated at 20 to 30 per cent overvoltage. If stock 105 volt lamps (obtainable direct

[1] The Barnett Optical Laboratories, makers of apparatus for anterior segement eye photography, have reduced the size of the reflex image of the lamp by using specially manufactured clear glass No. 1 photoflood lamps. The bare filament of this lamp becomes the source of light and the corneal reflex is consequently reduced to a minimum. A library of Kodachrome slides of typical ocular diseases and injuries has been collected, and duplicates of these are available to others.

from the lamp manufacturers) are used with a Variac or other adjustable auto-transformer, which gives about 135 volts maximum output voltage, the correct color-temperature will be obtained; or 3200 color temperature lamps can be operated at slightly above their normal voltage.

No reflector is used with the lamps since an image of the reflector would increase the size of the corneal reflex. In figure 1, the lamps are shielded from the operator by ordinary type lamp shade reflectors which are painted black and lined with a black wool material, the light absorbent action being similar to that of cotton velveteen or a deep-pile rug. By this means, the image of the reflector is eliminated, and the only image reflected from the eye is that of the filament itself. The room light should be kept at a low value so that no light of the wrong color-temperature is allowed to fall on the photographic field. If this extraneous light is kept at less than 1/30 of the photographic light value, there will be no appreciable effect on Kodachrome type A film.

(2) *Eyelid Reflex.* Inquiry among several authorities reveals that the accepted time interval for the eyelid reflex to sudden application of bright light, is about 1/10 second. This means that for best results, the whole operation of raising the lamp voltage, and taking the picture, should preferably be done in less than 1/10 second. Flash bulbs can be used, placed behind an opaque mask with a hole in it, but the



a

b

c

Figure 2-a, 2-b, 2-c. Black and white reproductions from full 35mm (24 x 36mm) Kodachrome films. Originals were taken at 1 to 1 ratio, with only one lamp. 2-a Iridodialysis. 2-b Embryotoxon. 2-c Posterior Lenticonus.

use of incandescent tungsten lamps as described above is more convenient. The snap-action (micro) switch is connected to the camera shutter release button as previously described, so that the lamps are brought to full brilliance just before the picture is taken. Focusing is done at low lamp voltage to reduce the photophobia.

(3) *Camera, Lens, and Image/Object Ratio.* The camera used should have ground glass focusing. It should preferably be of a focal plane shutter type, and permit the use of extension tubes to place the lens at the proper distance from the film in order to obtain the image/object size ratio needed. Since pictures in color are usually wanted, the camera should use 35mm film cartridges, or 828 size roll-film. Some vest-pocket size cameras and 120 roll-film cameras can be adapted to take 828 size film. This limits the cameras to two types: (1) Those with moving reflex mirror, such as the Exacta, Korelle-Reflex and Praktiflex; and Leica and Zeiss reflex attachments for their 35mm cameras. (2) Focal plane shutter type cameras can be used with a ground glass focusing attachment such as the Leica rotating or sliding focuser, or with the Speed-O-Copy which has been designed for use with the Leica, Contax, Perfex, Argus, or Ektra cameras.

The lens used can be either 2 inch (50mm), or 3 inch (75mm) focal length, preferably of f.4.5 or f.3.5 aperture. To obtain a life-size 1 to 1 (known as double extension) image on the film, extension tubes are used to increase the distance from lens to film by an amount equal to the focal length of the lens. The 3 inch focal length lens provides a greater free working distance (from lens to eye) than the 2 inch focal length lens. The respective distances are 6 and 4 inches. Supplementary lenses could be used instead of extension tubes, but the effect of a supplementary lens is to shorten the focal length of the combination. At 1 to 1 ratio, supplementary lenses usually introduce some aberration unless used at very small stops. At 1 to 1 ratio, a suitable supplementary lens would produce an equivalent focal length of 1 inch when used with a 2 inch lens, and 1½ inch focal length when used with a 3 inch lens. The lens to eye distance (free working distance) would be about 2 and 3 inches respectively, as contrasted with 4 and 6 inches when extension tubes are used. In all cases discussed above, the image/object size ratio is 1 to 1 (life-size).

(4) *Light Value Fixed.* When the lens is used at a fixed image/object ratio (preferably 1 to 1), and the lamps are arranged in a fixed relation to the camera, the light value on the field will always be the same. This is because the plane of sharp focus at the object is a fixed distance ahead of the camera, and thus at a constant distance from the lamps. When lenses are operated at nearly 1 to 1 ratio, it is necessary to move the whole assembly of camera and lens in relation

to the object plane, to bring the object into sharp focus. At exactly 1 to 1 ratio, moving the lens in relation to the camera and film is of no value whatsoever in focusing; at ¾ to 1, or ½ to 1, the lens can be moved in relation to the film for focusing, but for reasons of constant light value it is best to operate at a fixed ratio of magnification (fixed lens to film distance) to hold the lamp to field distance constant.

TECHNIC

With the apparatus shown, the whole stand is moved on the table top while observing the image on the ground glass. A useful refinement would be to use an ophthalmic stand, with an adapter to fit the camera and lights to the stand. The screw motions of the stand permit rapid and sure focusing.

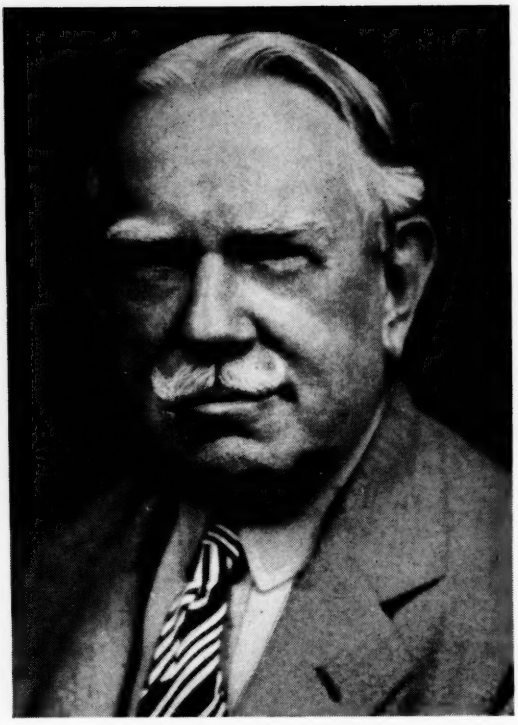
Focusing with the lens set at the taking f. stop eliminates one source of error, since it avoids the possibility of forgetting to stop down for the actual picture. Taking f. stop values vary from 3.5 to 5.6 with f. 4.5 average for 1/25 second with one lamp. Two lamps permit a shutter speed of 1/50 second. A 5 or 6 power magnifying glass should be used to examine the image on the ground glass. Although the image on the ground glass focusing screen will not be as brilliant at reduced aperture, the magnifier will aid considerably in focusing, and will eliminate the extra motion of reducing the lens aperture. The Exacta, Korelle-Reflex, and Praktiflex cameras have built-in magnifiers. Stock magnifiers are available for use with ground glass focusing attachments. While the incident light value on the object plane of sharp focus will remain constant, the actual reflected photographic light value will vary on different subjects due to the added light reflected from the skin area surrounding the eye. This variation will be as much as one full stop in either direction from the average value of f. 4.5. Negroes and Latins require more light (f. 3.5); blonde types and babies require less than the average light value (f. 5.6).

The camera should be focused upon the detail to be photographed, and not upon the bright reflex image of the lamp.

The usual procedure in taking a photograph with the equipment illustrated, is to place the patient's head on a chin rest and tell him what to expect. The camera unit should be used on a glass top table so that it will slide readily. The unit should be first adjusted for height for the individual, and then moved by the base until the image of the eye is centrally located on the ground glass; when critically focused, the picture is taken.

REFERENCE

The Leica Manual Morgan and Lester. New York. Several Editions.



Louis Schmidt

1866-1945

Mr. Louis Schmidt died in New York City on August 23rd, after an illness of a few months. An artist by nature, he did the microscopic drawings for the first American book on anatomy, by Dr. Piersol of the University of Pennsylvania; and also painted medical subjects for the Johns Hopkins School of Medicine. When Dr. Simon Flexner called him to New York to organize the Illustration Division for the Rockefeller Institute, he began to experiment in the application of photography to scientific research. He evolved his own technics and, using his knowledge of art and of the photomechanical processes, achieved photographs that were of outstanding quality for scientific publication. As a result, the Journal of Experimental Medicine, issued by the Institute, began to use an increasing number of photographic illustrations, and other Journals have gradually followed suit.

In 1931, when Ralph Creer, who was then photographer at the Yale School of Medicine, approached him with the idea of forming an Association of Biological Photographers, he agreed to join in the organizational work. He was made Chairman of the Committee to select a name for the new society and draw up its constitution; he was elected a Director at the first meeting; Vice-President in 1932 and President in 1934.

The B.P.A. was formed during the depression. Conditions were still bad when, in 1932, this small specialized group started their own journal. No one but the members who worked directly with him can have any idea of the thought and energy which Mr. Schmidt devoted to the problems of helping to establish the Journal on a sound footing; keeping the Association solvent and seeing to its incorporation; inaugurating the Travelling Salons and planning for the yearly meetings. As a gesture of appreciation, the members voted him the first Life Member of the B.P.A. in 1938. After the expiration of his Presidency, Mr. Schmidt continued to serve on the Board of Directors.

In many ways the B.P.A. is a monument to Mr. Schmidt. Since he was largely a co-founder, he is in part responsible for whatever it may become in the future. He wanted to see the standards of biological photography raised by the pooling of knowledge and the elimination of repetitive work; he wanted the Association to be a source of help and information to those who needed it and a medium whereby workers could contribute their findings for others; and, particularly, he wanted those who chose scientific photography as a profession to have a better chance of advancement and individual recognition. The best tribute we can pay him is to work for these objectives as he did, conscientiously, generously, and with unfailing friendliness.

Notes on Lantern Slide Processing*

Albert Sadler

THE following observations are presented chiefly on the basis of personal experience, with the idea that they may be of help to others in their work. The difficulties encountered in lantern slide processing have undoubtedly been met by many workers. Those of you who excel in this work will, I hope, bear with me.

Lantern slides of standard size, 3¼ x 4 inches, may be made from negatives of any size. There are two printing methods, contact, and projection, the latter including both enlargement and reduction. Contact printing may only be done from 3¼ x 4¼ inch negatives or sections of larger ones. There are advantages and disadvantages in both methods, however if the necessary equipment is available, projection printing is the method of choice. Its advantages far outweigh its disadvantages compared to those of contact printing, particularly because any size negative may be used.

Contact Printing

Contact printing, appears to be the simpler of the two methods, requiring only a printing frame or box. The negative emulsion side must be in optical contact with the slide. The image cannot be too large or too small to fit the lantern slide, allowance being made for proper margins. This must be borne in mind when making the intermediate negative from which a contact lantern slide is to be made. One disadvantage in this method is the difficulty of centering the image, for the negative is barely visible through the emulsion of the slide under the safelight. A fair degree of success in overcoming this difficulty may be obtained with practice. If the image is very much out of position it is advisable to make a new slide.

Projection Printing

Projection printing affords complete control of all factors and is quite accurate. The image may be adjusted to fit the slide, and none of the allowable printing space is wasted. Placing the image on the slide facilitated by means of a paper covered slide, which is ruled into sections for rectangular and square subjects, figure 1, and another slide drawn with circles for photomicrographs, etc., figure 2. The dimen-

* From the Department of Pathology of the Eloise Hospital and Infirmary, Eloise, Michigan. Received for publication May, 1945.

sions are as follows: In figure 1, the large rectangle is 2¼ x 3 inches, and the small squares are ¼ x ¼ inch. The border is ½ inch wide on each side. The diameter of the circles in figure 2 measure 2 inches and 2¾ inches, respectively. These slides are placed on the enlarging easel, at the intersection of the metal paper masks. By moving the masks, and keeping the corner of the slide absolutely square within the corner of the masks, the image may be centered on the slide accurately,

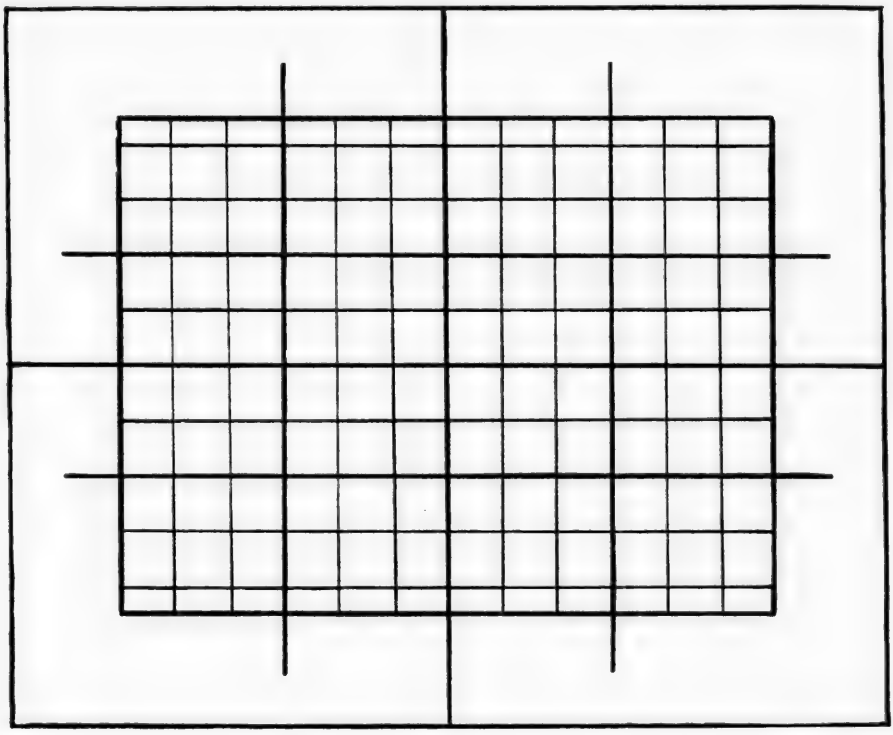


Figure 1

while its size and position in relation to the borders (to be masked), are determined by the distance from the negative to the slide. Since the ruled guide slide is of the same thickness as the lantern slide plate, good focus is retained when the ruled slide is replaced by the lantern slide. In the opinion of the writer, projection printing is the method of choice because of its many advantages.

ADVANTAGES AND DISADVANTAGES OF BOTH METHODS

Contact printing—Advantages.

1. Requires inexpensive equipment.

2. Negative costs are less.
3. There is less chance of picking up lint or dust on the negative.

Disadvantages.

1. Optical contact may not be obtained, unless the printer is of the best construction.
2. Intermediate negatives of the correct size must be made especially for this work. Lantern slide size negatives are too small

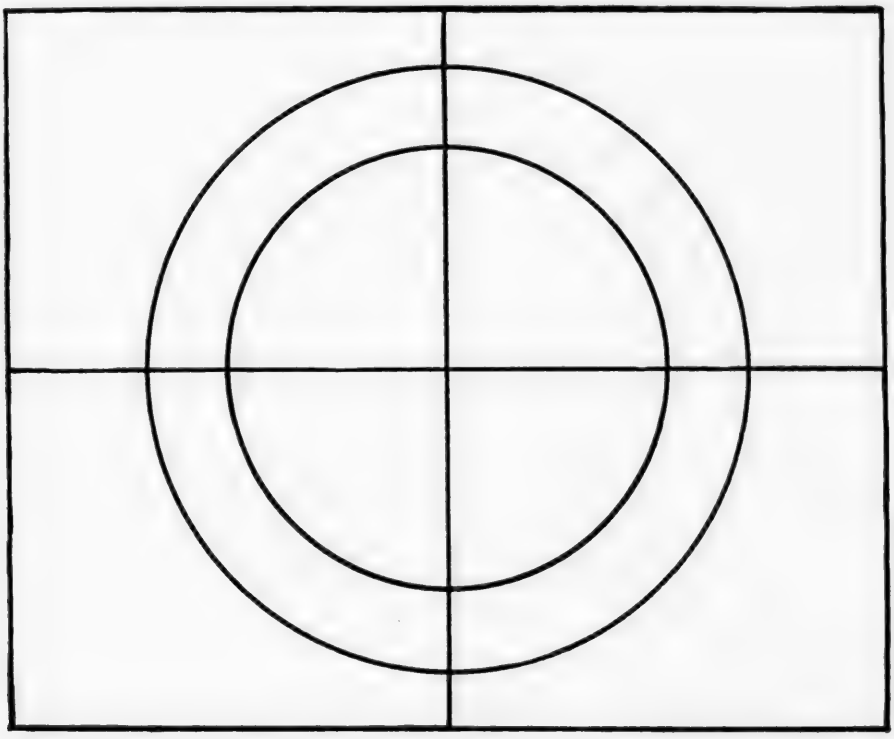


Figure 2

for a contact print which is large enough for medical illustration, which means that it must be enlarged to 5 x 7. Since both slides and prints are usually made from the same negative, one must either use 3¼ x 4¼ inch negative, contact printing the slide and enlarging the print; or a 5 x 7 inch negative, contact printing the print and reducing the slide. Of course, if the cost of the film is a consideration, 35 mm film may be used by projection for both purposes. However, a better quality print and slide are obtained from the larger negative, since

other things being equal, the larger the negative, the better the print.

3. It is difficult to accurately center the negative image on the lantern slide plate.
4. Local control (dodging and shading) is virtually impossible, unless one has a "professional printer."
5. Masking is tedious and may interfere with obtaining optical contact.
6. Estimation of correct exposure is not easy unless contact prints have been made.

Projection printing—Advantages.

1. Critical focussing is assured.
2. The image may be projected to the optimum size.
3. Straight line borders may be accurately paralleled to the slide.
4. In reducing from 5 x 7, blemishes and defects in the negative are reduced and made less obvious. Although one rarely finds such a blemished negative, it may happen at any time. Care should be taken as a matter of course to keep the negative and negative holder free from dust, lint and finger marks.
5. Dodging and shading may be employed.
6. Masking is simple and foolproof.
7. Estimation of exposure time is relatively simple, because one can see the projected image, and adjust the lens diaphragm according to the density of the negative. With experience, the visible image soon serves as a reliable guide.

Disadvantages.

1. Requires more expensive equipment. (This should *not* be a consideration in a professional studio).
2. In enlargement, blemishes and defects are increased in size on the slide and made more conspicuous. Great care must be exercised to keep the negative and negative holder clean.

MASKING

The negative must be masked on all sides. For circular photomicrographs or material requiring a circular border, a mask cut to the diameter of the circle to be used must be placed in contact with the negative. The image is then projected to a diameter of about 2 mm more than that of the No. 8 lantern slide mask which is used in binding. Failure to effectively mask all but the printing image will result in inferior transparencies, due to adventitious light reaching the plate

through reflection and scatter. One can easily prove this by making identical exposures, one masked, the other unmasked, and developing for the same length of time. The loss of brilliance and slight over all fogging with flat highlights, is quite noticeable, and is much worse with negatives having a thin background.

The masking of negatives for contact printing is not quite so simple. Paper masks should never be placed between the negative and the slide, they must be placed between the negative and the glass of the printer. The metal masks of the contact printer may be employed, provided they are thin, or the negative may be masked with Scotch tape, if time and tape are available.

Exposure

An average 5 x 7 negative printed by reduction requires an exposure of approximately three seconds at f. 32 on a normal plate, with a 500 watt bulb in the enlarger-reducer. The contrast plate would require about twice that exposure. A 2 x 3 inch negative with a 75 watt bulb and condenser enlarger, and an aperture of f.16, would require about 10 seconds. In contact printing, a blue 10 watt bulb at 30 inches is sufficient to yield an exposure of a few seconds. The standard light source in the printer can be subdued by covering the ground glass with the kind of blue paper used in wrapping absorbent cotton.

Speed and Contrast

Lantern slides are extremely fast compared to paper, about five times faster than Bromide No. 2, and eight hundred times faster than Azo No. 2 or other Chloride paper of the same grade.

Table of relative speeds[1] *(for slides printed by projection)*

Plate	*Speed*	*Dev. at 68F*	*Equivalent Contrast*
Eastman Medium	30,000	1 min.	Azo No. 1
Eastman Medium	40,000	2 min.	Azo No. 2
Eastman Medium	55,000	3 min.	Azo No. 3
Eastman Contrast	19,000	2 min.	Azo No. 4
Eastman Contrast	22,000	3½ min.	Azo No. 5

It will be seen from the above table that two slide emulsions will accommodate all negative contrasts by varying the time of exposure and time of development. Before printing lantern slides, (except line work) it is advisable to make a contact print and note the paper contrast and exposure time required. Once a factor has been established between print and slide exposure timing, it is a simple matter to calculate the exposure required for a slide in relation to the contrast. When printing a large number of slides, this will facilitate the work, at the

same time maintaining the high standard of quality obtained through accurate exposure and development. Test exposures in progressive strips may be made on slides, but experience soon makes this unnecessary. It is more economical to make test strips on Kodabromide No. 2 which has a relative speed of 8,000, and then compute the slide exposure mathematically.

SAFELIGHTS

Because slides are very fast, great care must be exercised in preventing them from becoming fogged either by the safelight illumination, or stray light leaking into an insufficiently light-blocked dark room. The manufacturer's warning to use the safelight only as directed is very important, being based on the results of his own experience. Use only the product of a reliable manufacurer, and be sure that safelights are changed every two years. They will fade eventually and no longer be safe according to their specifications. When installing a new safelight a piece of black tape should be stuck on an inside corner. This area will later serve as a visible guide in determining whether or not any fading has taken place, by removing the tape and comparing the patch underneath with the rest of the slide. Colored light bulbs or home-made so-called safelights should *never* be used.

For medium and contrast plates, a Wratten Series 0 is required at a distance of not less than three feet. Should the safelight be at a shorter distance, the developing tray must be covered with a black card, and the slide inspected for brief intervals during development. The Wratten Series 0A is preferred by some workers because it is brighter than the Series 0. Its illumination has a greenish hue as compared to the reddish hue of the latter, and the eye is more sensitive to green than to red light. It is advisable to use which ever series safelight you are in the habit of using, because correct judgment of slide density depends on experience, actual density, and the amount of light wherewith to see it. To prove this, view the same slide first under one safelight, then under the other. Notice how it appears to be darker under the Series 0.

DEVELOPMENT

Slides should be developed according to the contrast required. D 72 diluted 1 to 2 is satisfactory for both normal and contrast plates, the temperature should be 68 degrees F., and agitation continuous. A properly developed slide appears too dark. Highlights must be veiled, and the image should be clearly visible through the back when viewed by reflected light. Holding the slide in front of the safelight is a good way to judge the density, but do not hold it too close, nor for more than a few seconds. It should be viewed through the back. Because a slide of correct density appears too dark, the inexperienced

worker assumes that it is over-exposed and therefore prints one that looks just about right under the safelight. It takes some time to get over the urge to remove the slide from the developer or give another one less exposure. Such a slide, when cleared and examined under white light, is weak and underexposed, having poor contrast and quality. A good point to remember is that the eyes take several minutes to accommodate themselves to the dim illumination of the darkroom, and frequent trips out into the bright light or switching on of the white light in the darkroom, will interfere with the accommodation and make it difficult to judge the density of slides. A pencil flashlight is very useful in the darkroom, and should be used instead of the ceiling light.

Temperature

One cannot too strongly stress the importance of temperature control. Warm weather and lantern slide processing do not go hand in hand, for temperatures over 75 F. are fatal to good results. It is at this point that the emulsion begins to swell. Sometimes it is impossible to keep the solutions cool. If they are cooled by means of water in a second tray in which the processing trays stand, it is impossible to maintain coolness. The use of sodium sulphate in the developer, about 45 grams per liter of diluted solution should prevent swelling of the emulsion. A chrome alum hardening bath before fixation may be of help in preventing blisters and reticulation, but there are other things which occur during development which will spoil the slides. The emulsion swells very readily in a warm developer, and this predisposes to the formation of gas bubbles (carbon dioxide) when immersed in the fixing solution. This seems to be a common trouble during hot weather. Instead of an acid short-stop, a bath of plain water, or better still, a chrome alum bath (SB 3) is more effective in preventing gas bubbles resulting from the change from alkaline to acid. Even at normal temperatures, a strongly acidified short-stop will produce CO_2 bubbles.

Eastman Kodak Company states that the use of Kodalk in the developer will prevent the formation of gas bubbles, therefore, in hot weather when the temperature of the solution runs over 75F., it will be found more practical to use the tropical developer DK 15, which contains both Kodalk and sodium sulphate. This will minimize swelling and gas formation. The time of development at high temperature will be very brief. Should the developer be over 70F. other solutions must be at the same temperature. Below this point, a few degrees difference will do no harm, but approximately even temperatures should be maintained.

Another bad result from a warm developer is fogging of the plate, which in some cases is due to over-development; for example, if the developer is 70F. and in time rises to 75F. and developing time is the same fogging will result. This fog does not become apparent until the slides have been cleared and examined under white light. Over-development in a warm developer also produces a silvery white opalescence caused by the precipitation of calcium sulphite. This can be removed by bathing the slide in 5% acetic acid for a few minutes, but unfortunately, gas bubbles usually result. Moreover, even though the opalescence may disappear in the acid, some of it will reappear after the slide has been washed and the acid removed. In a recent article[2], Eastman Kodak advocates hardening the emulsion *before* development. The formula for this hardening solution (SH 5) will be found in the article, and is available, no doubt upon request to the Eastman Kodak Company, Rochester 4, New York.

FIXATION

Fixation should take place in an acid hardener (F 5) although a chrome alum fixer (F 16) may be used in hot weather. Since F 16 must be renewed frequently, the F 5 is preferable. The fixer should be reasonably fresh, and the slide agitated for several seconds after immersion. A hard rubber fixing tank holding twelve slides in an upright position is better than an open tray. If the fixer is too warm, sulphur stains will result. These stains appear as a yellowish-white veil over the entire slide. The use of potassium alum in the short-stop in a misguided attempt to harden the emulsion, will also produce sulphur fog, and so will a strongly acidified short-stop. Sulphur stains may be removed in a warm sodium sulphate solution, after treatment in the formalin hardening bath (SH 1). Slides do not respond favorably to warm solutions even after this type of hardening, and it is usually better and less trouble to make another one.

REDUCTION

Brilliance and contrast may be improved in some cases by a very brief reduction in potassium ferricyanide and hypo. Some workers, including the author, find that a slightly over-exposed and fully developed slide (that is fully developed according to the contrast required), following brief reduction, gives better results with certain subjects[3]. All slides from process negatives should be reduced for perfect results, using a weak solution of Farmer's R 4. It is sometimes of value to effect local reduction, using a tuft of cotton dipped in the reducer, care being taken that none of the solution runs over the emulsion. Unpleasant backgrounds can be subdued in this manner. When reducing slides,

a stream of running water must be at hand, this being the quickest way to halt the process.

Washing

Washing is best done in racks standing in a tank of water about six inches deep, rather than in trays. The temperature of the wash water should be between 65 and 70 degrees F. A minimum washing of twenty minutes is sufficient, provided that each slide has had a continuous stream of water flowing across the emulsion. Before washing, both sides of the slide should be wiped with a wad of absorbent cotton dipped in water, for these is usually a trace of the anti-halation backing present.

If the wash water is much below room temperature, reticulation may result, particularly when the slides are removed from the water for drying. If one suspects that the wash water is running far below room temperature after slides have been placed in it, trouble may be avoided by bringing the temperature up to that of the drying room by slowly adding warm water to that in the washing tank and allowing the slides to remain standing for several minutes, after which they may be removed and dried. If the room temperature is not above 65F. a colder wash water may be used without trouble, except that if it is too cold, say around 55F. or lower, the removal of hypo from the emulsion may not be complete even after one hour. Should one be faced with a combination of a hot day and cold wash water, the safest method of removing the hypo is by bringing a couple of gallons of water up to room temperature, and standing the slides in a hard rubber fixing box, changing the water every five minutes for one hour. Slides may also be placed in a large tray, then transferred to clean water in a second tray, and so on back and forth. This will avoid possible damage to the emulsion caused by slides coming together.

Reticulation will occur in hot weather if slides are held up in the warm air for more than a couple of seconds, and then replaced in the cool solution or cold wash water. In view of the probability of gas bubbles and reticulation when temperatures cannot be adequately controlled, it is advisable to avoid lantern slide processing in very hot weather, because the waste of time and materials is too great to warrant the effort. The only fool-proof solution is an air conditioned darkroom, and these are few and far between at the present time.

Drying

Slides should be dried in a rack, preferably in a current of dust-free air. They may be wiped off with a damp viscose sponge, provided the emulsion has not undergone even a slight swelling. If they have been swabbed with absorbent cotton before washing, using clean wash water, wiping before drying may be eliminated. The use of alcohol to expedite

drying is not to be recommended unless the alcohol is quite cool. A warm bath will produce opalescence[4]. A warm air current may be used after the emulsion has partly dried out, provided there is no swelling.

SPOTTING

Care taken in eliminating dust and lint from the negative and negative carrier at the time of printing will make spotting unnecessary. Because of the high magnification of the projected image, defects are rather obvious, whether they are dust spots or poor spotting. If spotting is necessary, use either spotting colors or Chinese ink, with a fine sable brush. Never attempt this work using reflected light; transmitted light is absolutely imperative. Use a viewing box or retouching stand, and if these are not available, hold the slide against a window.

MASKS

Standard projectors require that a mask be used around the sides of the slide. If the entire slide is filled with the image right up to the binding tape, a cut off may result. It is usual to allow a border width of ½ inch, in fact this is now standard practice. Prepared masks are available in twenty different shapes and sizes; rectangular (either vertical or horizontal), square, circular, and oval (vertical and horizontal). Round or square corners are available. Their use saves much time in cutting one's own masks, but they should only be employed when they satisfactorily frame the image with a small amount of background space between the specimen and the border. Too much blank space detracts from the strength of the screen image, for the specimen has a tendency to appear lost in the background while on the other hand, when the masks almost cut the edge of the image, it appears too crowded. Often, no standard mask will fit the subject with exactly correct margins, and then, instead of cutting one to shape and size, masking may be accurately effected by using the gummed strips of binding tape cut into 3½ inch lengths, and stuck onto the emulsion side of the slide to form right angle corners.

TITLES

If one is in the habit of identifying lantern slides with the name of the hospital or institution so that the name appears on the screen, one of two methods must be used. In the case of dark backgrounds, the negative must be lettered in black ink, of suitable size, so that the name will print in the lower right hand corner of the slide. When printing by projection, it is a simple matter to place the image so that the lettering is absolutely parallel with the bottom border. In contact printing, the lettering must be very small, and it is not easy to register it with the border, while with 35 mm film this method is out of the question. In the case of light backgrounds, printing in of such small

lettering is rather a problem. The easy way is to prepare a master negative on 5 x 7 film, from a black and white line copy of the name, either lettered or typed (block letters) on a large sheet of stiff paper. From this may be printed endless positives on process film. If the size of the lettering is correct for the slide, it may be done by contact, otherwise it will have to be done by reduction, care being exercised to make sure that the letters are the right size. They should measure approximately 1 mm in height. These film positives are then cut up on the guillotine into individual markers, making sure that the sides are parallel. Cut them close to the top of the lettering and allow three millimeters of margin on the bottom to allow for mounting on the side by overlapping with a small thin strip of gummed tape. They can be accurately placed in the lower right hand corner of the prepared masks, or the center bottom of circular or over masks, or on the tape masked slide. Before binding, the emulsion may be varnished to prevent condensation of moisture, but if slides are thoroughly dried and stored in a cool dry place, this trouble will not develop and varnishing may be eliminated.

Cover Glasses

Cover glasses should be of good quality, free from scratches and defects. They must be clean, greaseless, dustless, and I might add, free from finger prints. A Belgian glass has been available in the past, and will undoubtedly be available in the future. They are cheaper than domestic glass, but in quality are below the standard of American manufacture. It is necessary to wash them in soap and water. Many have to be rejected because of air bubbles, striations, defects and other breakage. They are not absolutely uniform in thickness. The number of good glasses in one case, after rejecting the bad ones, would cost almost as much as the domestic brand. The thin cover glasses supplied by Eastman Kodak or any other reliable American manufacturer are preferable, being of uniform thickness, quite clean, and free from defects. Lantern slides spoiled in processing may be cleaned and used as cover glasses. Soak them over night in a solution consisting of potassium bichromate 3 oz., sulphuric acid 3 oz., to 32 oz. of water. Another cleaning method consists of soaking in a solution of 1 oz. of lye to 32 oz. of water, for ten minutes. Wash well in soap and water and dry with a soft clean towel.

Identification

It makes for neater and cleaner title strips if they are mounted on the mask underneath the cover glass. Always include the negative number, name of the patient or title of the subject, the date of the photograph, and the diagnosis.

BINDING

Due to wartime restrictions, Scotch cellulose tape is unavailable for slide binding, and paper tape must be used instead. It is quite satisfactory and has the advantage that the slides do not stick together as they do with the cellulose tape. However, if for some reason the bound slide must be taken apart, the Scotch tape will come off readily, while the paper tape requires that the slide be soaked in water. If it is necessary to save the image, one must cut through the paper with a razor blade or scalpel and remove the cover glass before placing in water. The slide may be dried without harmful effects. In binding, a lantern slide binder is of value using cellulose tape, but not very useful for wet paper strips. Corners must be mitred for neatness, and the binding may be terminated at the last corner, cutting it off flush with the scissors, or it may be carried round the corner for one inch. By the same token, binding may be begun from either a corner, or between corners. A little experience soon allows one to wet the strips neither too much nor too little. Too much water will run into the slide and mar the emulsion, and too little water will result in the tape failing to stick to the glass. A damp viscose sponge is ideal for moistening the tape.

SLIDE NEGATIVES

This paper has dealt with the making of slides from negative emulsions. I have so far omitted mention of the use of lantern slide plates as negative material in the camera, for use as contact negatives in printing slide positives. While I do not use this method, many photographers do, and since I have pointed out the many advantages of projection printing from films, it is only fair that the advantages of glass contact negatives be discussed.

A lantern slide (positive) emulsion will not produce as good a negative as a film or plate (negative) emulsion, but it will produce a negative of certain subjects which will yield a lantern slide positive equal to that made from a film or plate negative. The value of the method lies only in copying either black and white line work, or continuous tone originals. Colored material may not be copied satisfactorily because the emulsion is sensitive only to blue. Its resolving power obviously is much higher than that of film, and therefore critical definition is obtainable. Exposures are long, since the comparative speed is extremely slow.

When a large number of copies have to be made expressly for lantern slides, this method saves time and money. The slide negatives may be developed twelve at a time, using a slide rack and a deep tank of D 11. About five minutes at 68F. will produce a negative of good

contrast. Since these negatives of similar subjects are usually of almost identical contrast and density, the positives may be printed rapidly and developed twelve at a time in the deep tank.

When copying the material, it is a simple matter to center the subject and parallel its borders to those of the plate. A 5 x 7 camera with 3¼ x 4¼ reducing back, using lantern slide plate holders, is ideal. The image may also be brought to the optimum size. This is one of the chief advantages of the projection printing method. In printing the positive, it is only necessary to squarely superimpose the plate over the negative to obtain correct placing of the positive image. Care must be taken to mask the negative. For this purpose, a 5 x 7 mask chart, cut out to slightly less than lantern slide size, is ideal. It should be placed between the negative and the printer.

Since there is usually no further use for the negatives, they may be cleaned and used as cover glasses. This saves much filing space and yields a good supply of flawless glass.

The advantage of the slide negative method lies in time saving, and it should not be used solely to save money. Film is preferable for copy work, and I repeat that cost of material at the expense of quality should not be a consideration in a professional photographic department, especially one serving a medical, biological or other scientific institution.

Comments

In conclusion, I would state that while the making of good slides for projection may appear difficult at first, a little experience and practice will soon produce satisfactory results, for excellent transparencies are obtainable from any good negative. The tonal range is much longer than that of the softest paper, and the available latitude in exposure and development will ensure excellent results provided you make the most of them. On the other hand, this latitude will result in very poor work if one cannot judge the negative, and this seems to be the trouble with beginners, so it is worth repeating that a contact print should be made in order to determine exposure and developing factors for the slide, using the table of relative speeds and contrasts.

References

1. Eastman Kodak Reference Book "Slides", p. 55.
2. Miller, H. A., Crabtree, J. I., and Russell, H. D. Popular Photography, 15:30 (October, 1944).
3. Harding, F. R. Jour. Biol. Phot. Assn. 13:100 (December, 1944).
4. Crabtree, J. I. Eastman Kodak Company. Stains on Negatives and Prints, p8.

Visual Education and the Photographer*

F. R. Harding

WITH a greatly increased use of visual aids due to get under way immediately after termination of the war, it would appear that the biological photographer should have some knowledge of how it is going to affect his or her work program. Following are a few of the things that will almost certainly be called for in the post war educational program.

More and better motion pictures in color, some with sound track, will be needed. Improvements will be needed in lighting color motion pictures. Many institutions will not have sufficient demand for sound films to install sound recording apparatus. Silent films will probably be made at a speed of 24 frames per second, which is sound film speed; sound can be dubbed in at a later date by a commercial sound laboratory.

It will be necessary to plan films more carefully than ever before, and more careful editing will have to be done, because the quality of educational films has improved greatly since so many training films have been made for the armed forces. Instructors are going to demand and get films as near the standard of wartime educational films as possible. A word of warning to these instructors might not be amiss at this point. They must remember that war training films were produced by a group of experts at great cost and with materials that few institutions can afford to buy. Therefore, they should not make too much criticism of films produced with more limited facilities.

Institutions will have to renovate their projecting equipment to a point where educational films can be properly shown. Sound motion picture equipment will have to be installed where it is now absent in many places. Equipment for projecting slide films, 2 x 2 lantern slides and standard lantern slides must be provided, with lens of proper focal length to produce a proper image size on the screen. A well designed projection screen should be provided, with means of protecting the surface when it is not in use. In addition, one or more portable screens should be provided for the use of small groups meeting in places other than the regular amphitheater.

The photographer will have to procure apparatus for the production of slide films, which will certainly be called for. Slide films are an

* From the Children's Hospital, Boston, Mass. Received for publication August 13, 1945.

excellent medium for visual education, but a warning must be sounded that they are inflexible material. By this is meant that the slides are on a strip of film in regular sequence. If at a certain lecture, only part of the film is needed, it becomes difficult to jump over many slides to show the ones desired. Lantern slides do not suffer from this trouble, as the ones to be used can be picked out, and a lecture made up without bad breaks in the continuity of the lecture. All these things must be kept in mind when a teaching series is to be made up. Photographers and instructors will find more conferences necessary before productions of any teaching aids are attempted. Only in this way will the utmost be gotten out of any lecture material being prepared. A greater variety of lenses of various focal lengths for use in the motion picture camera will be necessary in order to cope with increased use of motion pictures. Visual aids are not always in the form of slides or motion pictures. Do not lose sight of the use of enlargements for visual demonstrations before small classes. These often work out better than slides for small groups. All the apparatus mentioned here will be of no avail unless the photographer is willing to learn to use them. Biological photographers can be of great aid to the teaching staff by learning as much as possible about the many phases of visual education. Without knowledge in this field, the photographer will be of little assistance to the instructing staff when new teaching material is to be produced.

If more space is necessary in which to produce visual aids, it would seem a long term economy if the institution provided the additional space, because by so doing, improved instruction of students will result, which will in turn reflect to the credit of the institution.

It is the opinion of the author that biological photographers will have more to do with the preparation of exhibits for meetings than they have in the past. This will become necessary because of the greater use of transparencies, large prints and other photographic products, and the photographer will have a good knowledge of how they can be displayed to the best advantage. For many, this is going to mean a study of past exhibitions of all kinds, and the production of new ideas based on the amount of money which can be spent for such purposes by the institution. In the past, some of the most successful exhibits have cost very little money and some of the mose expensive have been notably unsuccessful in attracting attention to the material. A study of advertising display methods might be of material assistance.

Storage of visual aids is sometimes a problem to be overcome. In some institutions films are in the custody of the photographic department and the department is responsible for the care and projection of the material. It also means that someone has to be on call at night for projection purposes. It frequently precludes formal or informal

evening discussions because the material is not available 24 hours a day. In other places, the section or department having the films or slides made retains custody of the material and has a department member trained as an operator. In this case the photographic department acts only as caretaker of the equipment that is portable and does not supply an operator. The latter method is often the best, as the material is at hand 24 hours a day for informal sessions.

Biological photographers can render assistance of real value to the educational facilities of their institution if they will constantly be on the lookout for ways in which visual aids can improve the teaching program. It will appear from what has been written that all biological photographers will have new apparatus to learn to use, will have to study presentation methods, and have a knowledge of exhibit planning to care for future needs of visual education. A thorough knowledge of the various media for presenting visual aids, with their individual shortcomings, and the proper type of aid for small, medium and large groups should also be included in what must be learned.

Degrees Given for Work in Medical Art

Southwestern Medical College, Dallas, Texas, in cooperation with Southern Methodist University, has inaugurated a curriculum whereby students may gain their Bachelor of Arts degree, majoring in medical art and photography. Southwestern Medical College is inviting the cooperation of other colleges of Arts and Sciences in awarding the Bachelor of Arts degree on a similar basis. For students who have their Bachelor of Arts degree, graduate work will be given in the Department of Medical Art and Visual Education of the Southwestern Medical College leading to a Master of Arts degree. Further work may then be elected in the application of art or photography to medicine. When enough college credits have been obtained, the Medical College states that it will give a degree comparable to a Doctor of Philosophy.

Courses are now being planned for those who will wish to continue their work in visual education after experience in this field with the armed services. Professor Lewis Waters is in charge of the Department of Medical Art and Visual Education at Southwestern Medical College. Further information may be obtained from his department.

Advances in Endoscopic Photography and Cinematography

J. D. Brubaker *

Introduction

VARIOUS improvements in endoscopic camera equipment and technic have been made since the first descriptions were published[1,2]. This article is intended somewhat as a supplement to the original two articles, in order to make the description of such equipment more complete and up to date, and to show in what direction new improvements are proceeding. Sufficient time has elapsed to permit the proper evaluation of the relative importance of various features of design. During the past year, further research indicates

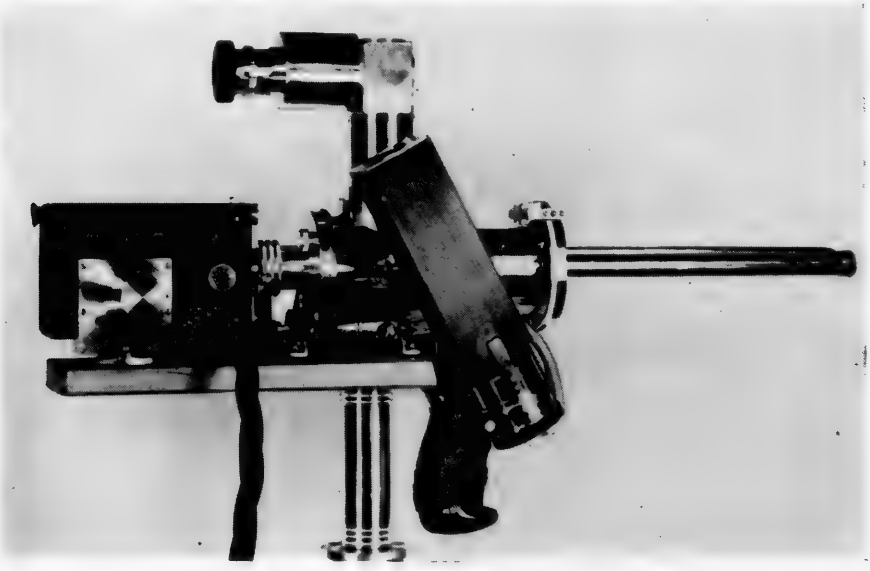


Figure 1. Proctoscopic camera with motor-drive.

that certain improvements are possible in the design of these endoscopic cameras which use proximal lighting. Most of the improvements described herein actually have been made and tested; others are somewhat theoretical, derived from carefully controlled experiments, and from projected designs, which are based upon the experience gained and theory

* Design and Research Engineer, 805 Greenleaf Street, Evanston, Ill. Received for publication July 12, 1945.

[1] Brubaker, J. D.: Proctosigmoidoscopic Cinematography in Kodachrome. J. Biol. Phot. Assn. 9:87-95 (Dec.) 1940.

[2] Brubaker, J. D.; and Holinger, Paul H.: The Larynx, Bronchi, and Esophagus in Kodachrome. J. Biol. Phot. Assn. 10:83-91 (Dec.) 1941.

developed as a result of such experience. A systematic exhaustive analysis has been made of all the basic optical, electrical, mechanical, and photographic factors controlling the design of endoscopic camera equipment of all types, including both proximal and distal lighting methods, as well as simple methods used to photograph relatively shallow cavities or small areas where high intensity coaxial lighting is desirable.[3]

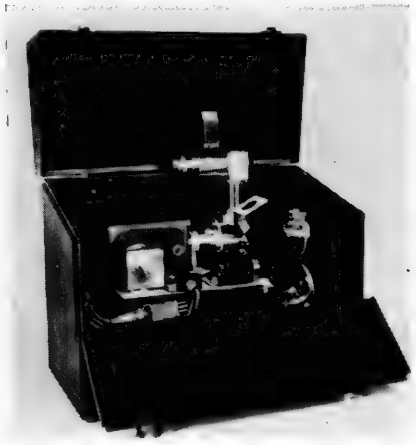


Figure 2. Carrying case with camera.

This article is divided into two main parts. Following the introduction, the first half deals with various aspects of endoscopic motion picture photography and equipment, using 16mm type A Kodachrome film. A motor-driven proctoscopic camera is shown to illustrate some of the improvements made in proximally lighted endoscopic motion picture camera equipment. The basic design of equipment for proctoscopic and peroral[4] endoscopic cinematography is almost identical, and many of the improvements can be considered to apply to both types of cameras. The chief difference is in the design and length of the endoscopes. The motor drive is optional, it being the most valuable in the case of proctoscopic pictures.

The second half of the article deals with the broader aspects of producing endoscopic still pictures through open-tube type endoscopes, suitable for record, publication, exhibit, or for group teaching by projection on a screen. A detailed description of the experimental proctoscopic still camera is given, to illustrate some features of design common to all endoscopic still cameras using flash bulbs as the photographic light source. Some proposed changes in still camera design are shown. The possibilities and limitations of enlarging single 16mm film frames for still pictures, are discussed.

Attention is directed to the sub-headings which serve to emphasize the topics covered. The bibliography includes collateral reading on endoscopic photography. Many of the references contain extensive and complete bibliographies within their special fields.

[3] In the monograph: Principles of Endoscopic Photography and Cinematography, by the author. To be published. Part of the material for this article was taken from the manuscript of the monograph.

[4] Peroral endoscopic photography includes mirror photography of the larynx and post-nasal space; and direct photography through open-tube endoscopes of: the larynx, trachea, bronchi, and esophagus.

Notes On Design Of Equipment

It has become increasingly apparent that endoscopic cameras must be carefully designed with a maximum of convenience and reliability of operation. Photography done with them must be done rapidly and surely with high predictability of results. In many cases, there is no opportunity to retake defective pictures. Without reliable operation,

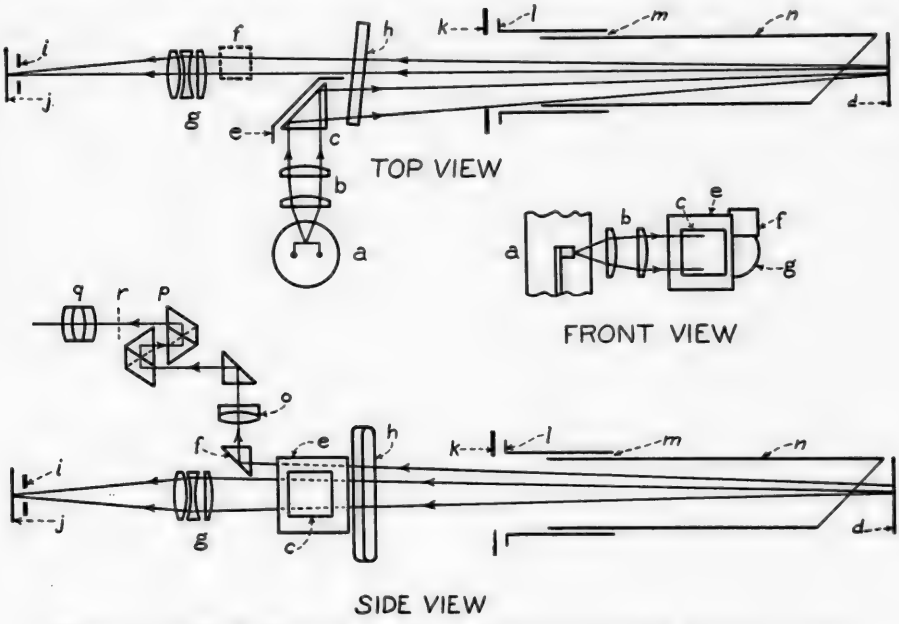


Figure 3. Optical diagram of typical endoscopic motion picture camera.

a—Ribbon filament lamp
b—Condenser lenses
c—Light prism
d—Plane of sharp focus at object
e—Septum and light shield
f—Telescope prism
g—3 inch focal length camera lens f. 3.5
i—Mask to shield film from flare inside endoscopes
j—16mm motion picture film in camera
k—Mask to absorb light flaring back from flange
l—Attaching flange of endoscope
m—Sleeve joint to allow adjustment of endoscope length
n—Laryngoscope, bronchoscope, esophagoscope, or proctoscope
o—Telescope objective lens
p—Porro erecting prisms
r—Image plane of eyepiece
q—Eyepiece of telescope

there is little incentive to take any great number of pictures. The primary value of endoscopic photography is in the ability to record a large number of typical and rare cases found in routine clinical practice, so that the pictures later can be projected and demonstrated to groups of medical personnel.

Some of the difficulties encountered in the design of satisfactory endoscopic camera equipment are due to the lack of interchange of ideas between the endoscopist and designer. It is simply that each has a large store of information of which the other is not aware. The best results will be obtained if the designer is present during actual endoscopy so that he can observe the routine technics of endoscopy at first hand, and form his own observations of important and unimportant factors which govern the design of convenient equipment.

It is only by close association with the actual use of endoscopic camera equipment, that the necessity for fully perfected equipment becomes apparent. The necessity for refinements of design and workmanship can be evaluated and fully appreciated only by actual observation of the equipment in use.

16MM MOTION PICTURE PHOTOGRAPHY

The Importance Of Endoscopic Motion Pictures

Endoscopic motion pictures in color are especially valuable for visual educational purposes, since they present the subject-matter in a dynamic manner, showing the field in motion as actually seen by the endoscopist. The image on the screen is seen slightly enlarged[5], and often allows a better study of certain details than can be made during the brief interval of an actual endoscopic examination. The motion picture differentiates the normal appearance of the field from the somewhat idealized illustrations shown in text-books. The characteristic movements of the endoscopic area, caused by respiration, pulse, and involuntary motions of the viscera, all are shown, and thus more clearly present the actual appearance seen during endoscopy.

16mm Endoscopic Cameras

Figure 1 shows a motor-driven model of a proctoscopic 16mm motion picture camera[6] designed to take pictures with Kodachrome type A film. Several improvements were made over the previously described[1,2] endoscopic motion picture cameras of this general design. Figures 2, 3, 4, 5, all apply to this camera. In many respects, the illustrations apply to all of the motion picture cameras, whether for peroral or proctoscopic use. The cylindrical stub in figure 1 supports the camera on a tripod while adjusting the camera. Figure 2 is shown to demonstrate a convenient type of carrying case for this kind of

[5] The following analysis of magnification is based upon the angle subtended by the image, at the eye: Consider the eye-to-field distance as 15 inches for a normal visual endoscopic examination. Assume the field to be ¾ inch in diameter (20/1 ratio). The field is about .160 inch in diameter on the film. Most projectors use a 2 inch focal length projection lens. 2.000/.160 is 12.5/1 ratio. 20/12.5 is 1.6 magnification. The respective angles are 2°-50′ and 4°-35′. For persons seated near the projector, the magnification will be 1.6 times. With a 4 inch focal length projection lens, with the projector at the rear of the room, this same magnification will be seen by persons seated half way between the projector and screen.

[6] Built for Dr. Louis A. Buie, Mayo Clinic, Rochester, Minn. (A previous motor-driven camera, with a motor continuously winding the spring, was made for Dr. Garner and mentioned in the article under footnote 1).

equipment. The camera is held in a recess in the case, by a cushioned block in the cover. More recent carrying cases have a long compartment in the lid for the endoscopes. In peroral endoscopic photography, as many as four or five different endoscopes are needed for best results in photographing the various areas.

The Proctoscope

A standard length 10 inch (25cm) proctosigmoidoscope of ¾ inch (19mm) diameter is used[7]. The light carrier tube is wholly on the outside so that it does not appear in the photographic field of view. The inside of the scope is polished to increase the photographic light reaching the field.

The Air-Seal Glass Slide

In the proctoscopic camera, an optically flat glass slide, figure 3, has been arranged to act as a removable air-seal window to permit air inflation of the bowel when necessary. (Previously, slides were used

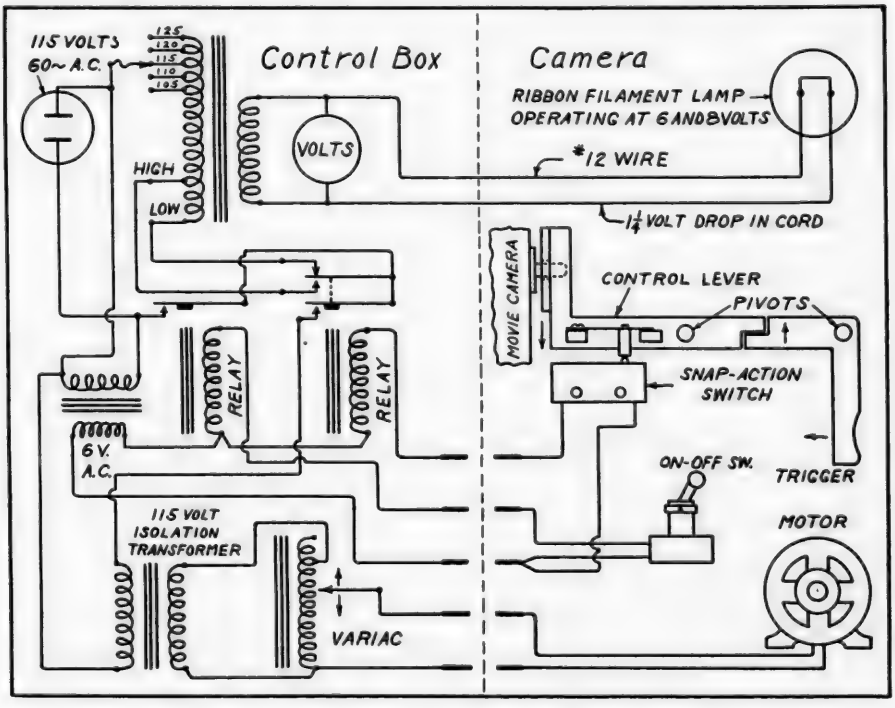


Figure 4. Electrical diagram of motion picture camera.

only to shield the optical parts from soiling and condensation of moisture). The slide is carefully fitted on the front side. When the

[7] Supplied on special order from: The Electro Surgical Instrument Company, Rochester, N.Y.

slide is inserted in the slot in the main housing, it is loose in the slot until it reaches a point about 3/16 inch (5mm) from the bottom. At this point, a roller and lever system, actuated by the slide, clamps the slide firmly against the front face of the slot. The fit is very nearly air-tight, and adequate for the few ounces air pressure built up with a hand bulb. By this means, the air-seal is made without scratching or smudging the glass slide.

Camera Film Mask

A permanent circular mask, see figure 3, was installed inside the camera box film aperture, behind the shutter. The mask was placed within 1/32 inch (1mm) of the film to mask off the reflections from the inside bright surface of the proctoscope. Placing the mask at the film plane is more effective, since the camera lens aperture is semi-circular, and an out-of-focus mask in front of the camera shutter does not mask close enough to the circular image on the film for best results. The masked reflections are in motion when the endoscope is drawn through the lumen of the passage, and would be very disturbing if seen during the projection of the film.

Camera Shutter Efficiency Increased

It has been found possible to cut about 35 degrees off the shutter blade in the Bell and Howell 141 and Auto-Load cameras, when the film area actually used is only .200 inch (6mm) in diameter or less. This gives about 25 per cent longer time that the light remains on the film for each film frame. The new shutter speed becomes 1/34 second instead of the standard 1/43 second shutter speed at 16 frames per second.

This change, combined with some minor changes of clearance in the lamp condenser system, has totalled an equivalent gain of about 50 per cent increase in light value on the photographic field. This is a considerable advantage when the area photographed does not reflect a high percentage of the incident light, back toward the camera lens.

Motor-Drive

The special motor-drive on the camera shown in figure 1 was made so that a full 50 foot magazine of film could be taken without stopping to wind the camera. This is desirable since a continuous scanning of the bowel wall, from the sigmoid all the way to the anus, takes about 25 to 40 feet of film, and the standard spring-driven camera takes only about 12 feet of film with one winding. Winding the camera when the equipment is in place, attached to the endoscope, ready for photography, is a time-consuming operation and interrupts the attention of the endoscopist while he is engaged in concentrating on the problems of photography.

The spring drum was removed, and a drive-shaft and gear was extended through the camera wall to engage the gear-train in the camera. The 1/100 hp, 115 volt ac series-wound motor drives through a worm gear and slipping clutch, with the motor torque adjusted by means of a Variac[8] adjustable auto-transformer, see figures 4, 5. By this method, instead of using a series resistance, the rapid starting characteristic of the series-wound motor is maintained. The camera and motor speeds are both governed by the regular mechanical governor inside the camera. The motor torque is adjusted by the output voltage of the Variac, to be slightly less than that value required to slip the clutch. The clutch friction slips at a torque equal to that delivered by a fully wound spring drum. The clutch also protects the gear train from damaging inertia effects when the camera is suddenly stopped. The drive motor operates through a relay which closes when the lamp voltage is raised. The action of the trigger and camera control lever is shown in figure 4. The snap-action switch, sometimes known as a micro-switch, is actuated by a device on the control lever. The device has a leaf-spring and stud, adjusted to operate the switch at a certain point in the travel, just as the camera release button starts downward. The leaf-spring is lifted off the fixed part of the lever, to provide over-travel and positive operation. A 1 to 1 voltage ratio isolation transformer is used to isolate the motor current from the 115 volt ac line, since the motor commutator insulation is not reliable enough to insure complete safety against electrical shocks to ground from the 115 volt line. It is reasonable to assume that light-weight 16mm cameras with built-in small electric motors may become generally available in the not too distant future, since cameras of that type are now used in aircraft by the military forces[9].

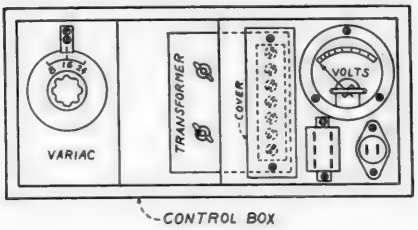


Figure 5

Endoscope Design

On cameras for proctoscopic photography, the plane of sharp focus is placed about ½ inch (12½mm) beyond the tip of the proctoscope. The adjustment is fixed at this distance. On cameras used for peroral motion picture photography, the endoscopes are made with a telescoping sleeve, figure 3, to allow adjustment of the endoscope tip in relation to the fixed plane of sharp focus. The endoscopes are made

[8] Catalogue ‡ 200-B unit, General Radio Co., Cambridge, Mass. Similar units are available from other manufacturers and can be found in catalogues of radio supply houses.

[9] Harrison, C. A.: Wartime versatility in aerial cameras. American Photography. 39:18-21 (Mar.) 1945.

with a taper of about 3/8 inch per foot for several inches near the attaching clamp, to provide more clearance, and to reflect more light from the condenser and lamp to the photographic field. For greater clearance, it has been found desirable to make the adjusting sleeve joint about 1 inch (25mm) in diameter. Earlier joints were made about .850 inch (21mm) in diameter. Larger sleeve joints permit a larger mask to be used at the attaching flange, see figure 3, with better clearance for the rays of light to the telescope focuser prism. Holinger and Park† have devised a rack and pinion knob adjustment with detents, for adjusting the total length of the endoscopes. This adjusts the distance from the object plane to the tip of the scope. The scope can be rotated, independently of the length adjustment, for proper orientation of the extreme tip, as required in some peroral endoscopic photography where the scope must be rotated after introduction into the patient.

Location Of Handles For Endoscopic Cameras

On endoscopic cameras, the angle at which the camera will be held during use must be considered. The center of gravity of the whole unit lies above the base, and will require a different location of the handle for the most comfortable support for different angles of use. The proper location of the handle will place the center of gravity directly above the hand. For proctoscopic use, the angle is about 45 to 60 degrees from the horizontal, for photography with the patient on a standard proctologic table. For direct peroral endoscopy, the angle is about 15 to 25 degrees from the horizontal. The proper point of balance eliminates most of the difficulty caused by the weight of the camera; the proper shape of the handle makes the camera grip relatively secure and comfortable. A notched filler-block for the middle, ring, and little finger helps provide the proper shape of the grip. The hand can resist any tendency for the camera to fall backward, but resistance against tipping forward is awkward.

Measuring Light Value On The Field

In order to provide an over-all check on the proper position of the lamp filament, condenser focus adjustment, lamp efficiency, and reflectivity of the inside of the endoscopes, an exposure meter is now used to measure the light intensity coming out of the endoscope tip. Thus all factors affecting the incident light value on the photographic field are checked together in one reading. This includes the degree of blackening on the inside of the ribbon filament lamp caused by tungsten evaporated from the filament. An exposure meter such as the GE is used, with a 1/8 inch (3mm) diameter opening in an opaque mask on the photo-cell glass. The meter is used in an empiric manner, using a standard value of meter reading, determined by measuring the

† Paul H. Holinger, M.D. and Wm. B. Park, Winnetka, Ill.

light value which is found to produce satisfactorily exposed Kodachrome film. With a ⅛ inch hole, readings from 20 to 30 are obtained with the various endoscopes. This corresponds roughly to a normal arrow setting on the Weston meter of 160 light value, used to calculate the aperture and shutter speed for the camera setting. For a lens of full circular aperture, 160 corresponds to about f. 8 at 1/40 second. The exposure meter would be more reliable if a larger hole were used (about ½ inch in diameter)[10] with a neutral density filter made from a piece of fogged film placed between the mask and photo-cell glass. This would reduce the unit light intensity per square millimeter on the photo-cell surface.

Stereoscopic Effects In Endoscopic Motion Pictures

The fundamental fact of simulated stereoscopic vision, seen in projected endoscopic pictures has not received the attention it deserves. Some of the most attention-compelling scenes observed in endoscopic films projected before medical groups, owes a substantial part of such interest to the fact that a perspective effect is produced which is similar to stereoscopic vision. This is in addition to the novel effect of taking the audience on a "subway tour" of the passages seen.

Ordinary stereoscopic still photographs are made in one of three ways. They are (1) made with a camera having two matched lenses, taking two pictures simultaneously, or (2) one camera is used, and it is moved laterally between two successive pictures. (3) The same effect as lateral displacement of the camera is obtained by rotating the object itself through a small angle, about an axis passing through the plane of sharp focus.

It is obvious to anyone who has seen endoscopic motion pictures, which were taken while the endoscope was being slowly withdrawn, that the axis of the lumen (passage) beyond the endoscope tip is almost constantly being shifted at varying angles to the endoscope axis, the effect being exactly the same as the rotation of an object. In this way, a stereoscopic concept of the passages photographed is constantly being built up in the mind of the observer, even though the camera and projector used is a monocular type system. Similar effects have been produced in professional and amateur motion pictures of ordinary subjects by swinging the camera about the object.

Endoscopic Still Photography

Endoscopic Photographs For Publication

Since relatively few endoscopic color photographs have been published, special mention of those in print is indicated, so that typical

[10] Maurer, John A.: Exposure control in photomicrography. J. Biol. Phot. Assn. 12:p 175 (June) 1944.

examples of such color plates may be examined by persons interested in taking endoscopic color photographs. The series of six color views made by Dr. Holinger[11], which represent the various stages seen while exposing the larynx by means of a laryngoscope, has been printed as a frontispiece in a book[12]. Color prints of the larynx, from Kodachrome, are printed in a new book, in the chapter on endoscopic photography written by Dr. Holinger[13]. Hantman's article contains eight color views of typical ear-drum pathology[14]. He used a Cameron camera[15]. Eight proctoscopic color plates, taken with the camera described below, have been published[16].

Black and white enlargements from Kodachrome originals, taken with the proctoscopic camera, were published in the December, 1940 article[1]. Black and white prints made from Kodachrome still pictures, and prints from single frames of 16mm Kodachrome motion picture film were reproduced with the December, 1941 article[2]. Two comprehensive articles by Hull[17,18] contain reproductions of typical endoscopic black and white photographs made through endoscopic lens-filled instruments.

By comparing the above published color pictures with color drawings in text-books, the advantages and limitations of endoscopic color-photography can be evaluated. An examination of the black and white pictures published, will demonstrate what characteristic details can be shown satisfactorily in black and white. It is obvious that a perfect color-photograph is superior to a color drawing made by an artist, for certain types of pathology. The photograph shows how far the actual appearance, seen during endoscopy, departs from the idealized conception of the drawing. Sometimes the drawing will show certain details better, in a diagrammatic way, than any photograph could. The two mediums for illustration should be kept somewhat separate in one's mind, since they each have a superiority over the other within certain narrow limits. For example, the photographs often show difficulties seen during endoscopy, as caused by secretions and reflections; the drawings usually do not.

Enlargement Of Single 16mm Film Frames

For endoscopic color pictures which are intended for publication as color plates, there is no alternative but to take them originally with

[11] Made with the still camera described in the reference under footnote 2.

[12] Endothracheal Anaesthesia. Noel A. Gillespie. University of Wisconsin Press. Madison, Wisconsin. 1941.

[13] A Textbook on the Nose, Throat, and Ear, and Related Diseases. Edited by Chevalier Jackson, M.D., and Chevalier L. Jackson, M.D. W. B. Saunders Co., Philadelphia & London. 1945. The color plate shows ten views including the normal larynx, tumors of the larynx, and four stages seen during the introduction of a laryngoscope.

[14] Hantman, Irvin.: A Simple Technic for Photography of the Drum Head. Archives of Otolaryngology. 34:7-10 (July) 1941 (Am. Med. Assn.).

[15] Cameron Surgical Specialty Co., 666 W. Division St., Chicago, Illinois.

[16] Pessel, J. F.; Garner, J. M.; and Nesselrod, J. Peerman: Proctoscopic Cinematography. Am. J. Dig. Dis. 9:140 (April) 1942. (Eight color prints about 2 inches in diameter).

[17] Hull, W. M.: Endoscopic Photography. J. Biol. Phot. Assn. 9:59-72 (Dec.) 1940.

[18] Hull, W. M.: Chapter on Endoscopic Photography in the book: Medical Physics. pp. 920-933. Year Book Publishers Inc., 304 South Dearborn Street, Chicago, Illinois, 1944.

a still camera. Color prints have been made from full single 16mm Kodachrome frames of ordinary subjects, but color prints from single endoscopic 16mm frames usually are not practical due to the small size of the film circle used. The fine gradations of color in small areas of 16mm Kodachrome film does not show up well when the single frames are reproduced as color plates. When the 16mm motion picture film is projected on a screen, the eye averages the detail of several

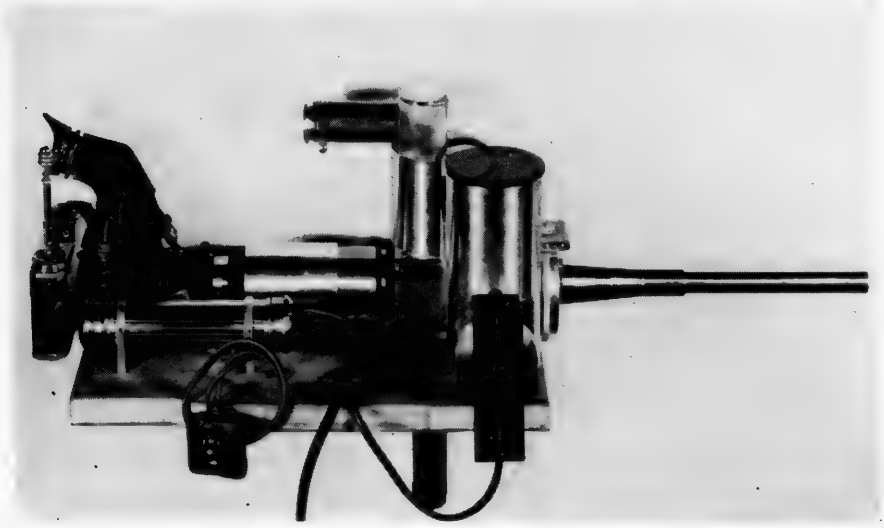


Figure 6. Experimental proctoscopic still camera.

16mm frames together, over a period of about ¼ second, and a false conception of the relative sharpness of the individual frames is formed by persons not acquainted with 16mm motion picture films. So, each frame is less sharp than expected.

Fewer than expected still color photographs of endoscopic subjects have been published, partly because much of the important work in the general field of endoscopic color-photography has been done with 16mm motion picture cameras, used to produce films for visual educational purposes[19]. Since a considerable amount of typical endoscopic subject matter has been recorded on 16mm Kodachrome film, the question naturally arises as to what extent such films can be enlarged in black and white, to produce still pictures. Carefully selected individual frames can yield fairly adequate black and white still pictures when the individual Kodachrome frame is enlarged. Slightly underexposed films yield better copies than overexposed films. The subject matter must be selected to have fairly bold outlines and good contrast in light and dark areas in the finished print. Delicate gradations usually

[19] Important work in the field of 16mm endoscopic color motion pictures has been done by: Garner and Nesselrod; Buie; Holinger; Clerf; and Pressman.

do not make good copies. The film area on the individual frame should not be smaller than about .150 to .200 inch (4 to 5mm) in diameter. Film areas smaller than .150 inch in diameter usually do not produce satisfactory copies except where the field has very bold and coarse contrasts. Some suitable subjects for copying in black and white would be: the larynx, trachea, bifurcation, and multiple division of the lower-lobe bronchus; rectal valves, rectal pedunculated polyps before and after fulguration (burning with a radio frequency arc), and multiple polyposis where reflected high-lights assist in showing the rounded contour of the polyps. The relative sharpness of stills, versus enlarged single 16mm frames, can be seen in the plate of black and white larynx and bronchi pictures in the 1941 article[2].

Still Cameras Using Flash Bulbs

Figures 6 and 7 show the original experimental proctoscopic still camera built for Dr. Garner[20]. While the camera obviously has a somewhat crude physical appearance, it has produced excellent Kodachrome pictures of good size[16], and has provided much fundamental knowledge of the proper basic design of endoscopic cameras using flash-bulbs. This type camera combines the camera, focusing telescope, and light source in one unit, with proximal illumination, see figure 7. The focusing lamp and condenser contained in the small square lamphouse, projects light through the wire-filled flash-bulb, onto the diagonal mirror, and down the special proctoscope. The flash-bulb used is of large size with a glass bulb about 2½ inches (64mm) in diameter. Numbers 50, 31, and 2-A types have been tried. While smaller size flash-bulbs may be practical in certain cases, the use of large size bulbs appears necessary to obtain the absolute maximum light value on the photographic field. The maximum light value is necessary to permit the use of a long focal length lens, required for taking the largest possible diameter Kodachrome picture on the film.

In figure 7, the telescope objective lens is of 5-3/16 inch (132mm) focal length. The eyepiece focal length is 1 inch (25mm), giving a magnification of about 6 diameters of the field at the tip of the proctoscope. The camera lens is a 6½ inch (16.5cm) focal length tessar, operating at a marked aperture of f. 11 (⅜ inch (16mm) physical diameter for the entrance pupil). The effective marked aperture is f.16 since the telescope prism covers half of the lens. The increased light needed for proper exposure of the film, as required by the lens extension, makes the corrected final value actually f. 25. The lens to object distance is 14 inches (35cm), and the lens to film distance is 10 inches (26cm), making the film image/object size ratio about 0.7. The ⅞ inch (22mm) diameter proctoscope becomes .550 inch (14mm)

[20] The camera is mentioned in the references under footnotes 1 and 16.

in diameter on the film for the actual picture. For proctoscopic photography in color, this is about the best ratio that is practical when Weston speed 12 color film is used. As mentioned before such a relatively large diameter picture is made possible by the use of large size flash

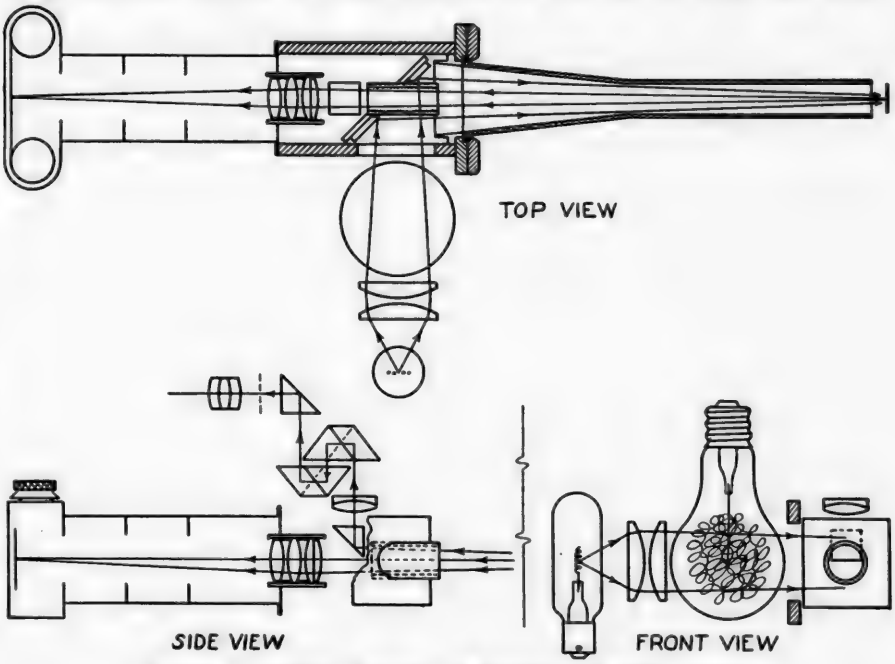


Figure 7. Optical diagram of proctoscopic still camera.

bulbs. This size picture is much smaller than is desirable, but the laws of optics, chemistry and mechanics limit the practical size of the picture when pictures are taken with instantaneous exposures.

Calculations made on the Weston exposure meter calculator dial, using the true lens stop of f. 25, show that the light value from #2-A and #31 (focal plane type) flash-bulbs, is about 1000 foot-candles reflected light for 1/25 second; a #50 bulb (peak type) produces about 2000 foot-candles reflected light for about 1/50 second. This is at the tip of the proctoscope. An examination of the published graphs showing light intensity in relation to the flash duration for these bulbs, indicates that the total photographic effectiveness of light obtained from a #50 bulb (average intensity multiplied by the time for the total flash duration) is nearly 1½ times that produced by the #2-A and #31 bulbs.

The 2000 foot-candles given, is the value found on the Weston Exposure-meter calculator dial by extrapolation[21] from the true stop

[21] For example: 2000 foot-candles is 3 spaces beyond the 1000 mark on the calculator dial. 500 to 1000 is 3 spaces. Therefore 1000 to 2000 is 3 spaces projected beyond the 1000 mark at the end of the marked scale.

of f. 25 and the 1/50 second shutter speed, found by trial to be correct for the proper exposure of Kodachrome type A film. This film has a Weston speed of 12. A general analysis of still cameras[3] shows that illumination from flash-bulbs usually will fall in the range of 500 to 2000 foot-candles, reflected light. The incident light on the field from the flash-bulb is about 8 to 10 times the reflected light-value, making the range of incident light-values about 5,000 to 20,000 on the field of view for most cameras of this general type.

The reflex focusing box shown in figure 6 is not used for focusing, it being used because the assembly of Contax camera, reflex box, extension tubes, and lens, was already on hand. The 35mm still camera box and flash-bulb are synchronized, using a magnetic electrical release with push-button for releasing the camera. Recent study shows that for endoscopic cameras, the open and shut type of synchronization is more desirable, since many inherent difficulties are encountered when trying to synchronize the flash-bulb and focal-plane shutter. The open and shut method is where the total flash duration of the bulb is utilized, means being provided so that the bulb fires at some time during a slow shutter speed interval of about 1/10 to 1/2 second. Thus, all the light from the flash-bulb is used, the actual exposure time (shutter speed) being that of the flash duration of the bulb itself. The light-value on the field, produced by the focusing lamp, is below the threshhold value for Kodachrome film for the brief interval during which the camera shutter is open. Moreover, when the bulb fires, the white deposit on the inside of the glass bulb acts as an opaque curtain, and reduces the focusing light-value on the field to a low level until the bulb is removed. More recent designs extinguish the focusing lamp just before photography to avoid any possibility of fogging the film.

The Proctoscope

The proctoscope, figure 6, 7, has a large diameter cone at the proximal end, to clear the large bundle of light rays from the flash-bulb and to reflect additional light to the straight portion of the endoscope. The whole internal surface of the endoscope is polished and nickel-plated for maximum light reflection. While the free working length of the scope is only about 6 inches (15cm), it is long enough to photograph all types of pathology found during proctoscopic examinations. The inside surface of the scope, near the tip, is threaded for a distance of about ⅝ inch (16mm), to show up as a ring around the photographic field, on the film, so that the area wanted can be seen in the finished film. Paper masks of this diameter are attached to the finished film to mask off all the area except the circular field wanted.

New Developments In Still Cameras

Recent detailed analysis shows that the basic optical design of the proctoscopic camera, with some modifications, can be used for broncho-

scopic and esophagoscopic photography, using a special endoscope about 16 inches long, with a free working distance of about 12 inches (30.5 cm). The basic optical design of such a camera is shown in figure 8. The design shown in figure 8 allows the use of a focusing type lens arrangement, which permits the plane of sharp focus to be adjusted up to several inches beyond the endoscope tip. Also, a continuous rack and pinion focusing motion can be provided to allow photography at either the 10 inch (25cm) distance, or the 16 inch (41cm) distance, with the range of focus such that the plane of sharp focus can be placed at any distance in between the two positions. The camera and telescope are both focused together for any position of the lens, since the same lens is used for both optical paths. The light for the telescope is diverted by the beam-splitter cube as shown, or for higher efficiency, a movable prism can be used, the prism moving out of the light path just before the picture is taken.

In the first movie and still cameras built, the prismatic erecting "porro system" of the "first form" was used, and two unnecessary right

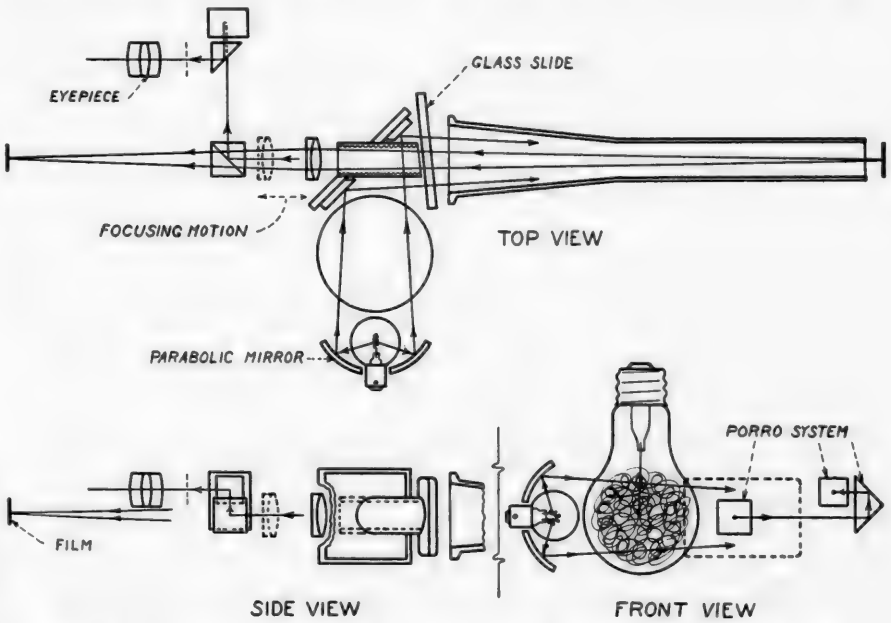


Figure 8. Optical diagram of endoscopic still camera with focusing lens.

prisms used. Certain factors in mechanical construction made it expedient to use this somewhat less desirable optical design, figure 3 and 7. Study shows that the "second form" of porro erecting system (which divides the two porro prisms into 3 or 4 separate prisms) allows the objective-to-eyepiece distance to be made shorter, and provides means to locate the eyepiece axis in a more advantageous position. This

second form is a basic change incorporated in the design shown in figure 8.

The focusing type lens described above would be a decided advantage when photographing the larynx by the indirect mirror method. Since the mirror is fixed on the end of a shorter endoscope, used to direct the light, a focusing lens is the only completely satisfactory method which can be used to compensate for the variable mirror-to-larynx distance found in different patients. Then, too, variable focus is valuable when photographing the larynx, trachea, bronchi, or esophagus, where the focus varies from ¼ inch (6mm) inside the endoscope tip (for esophagus), all the way up to about 3 inches (75mm) beyond the tip when photographing the bronchi.

The focusing lens system is more convenient than the method (on the movie camera) of changing the sleeve adjustment, see figure 3. Rack-and-pinion focusing with a knob, is more rapid and satisfactory than the method of placing the plane of sharp focus at a fixed distance beyond the endoscope tip. The latter method requires the whole camera and endoscope to be moved along the lumen of the passage to bring the field into sharp focus. The slow rate of change in focus makes it somewhat difficult to judge just when the field is in sharp focus. Rack and pinion focusing permits more rapid and precise focusing by the well known method of rapidly focusing back and forth past the point of sharp focus, finally returning to a point remembered to be half way between two points where an equal degree of unsharpness was seen to exist.

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Medical Records

Arthur W. Fuchs *

V-J DAY brings to a virtual close the use of photography as a tactical tool of tremendous importance to the Armed Forces. Bombing expeditions were customarily planned from reconnaissance photographs, largely in color, of areas designated for attack. Hence, tactical information became available by reason of intensive study of photographic surveys and all interested personnel had a substantial visual impression of what was to be accomplished.

Medical photography, however, will continue to be used in all military hospitals for some time to come. Splendid work has been accomplished in making record photographs in color, and black and white. Some phases of the work, obviously, have been of diagnostic significance.

The liberal provision made for medical photography by the Armed Services has made it possible to build an enormous stock of valuable medical data of many kinds. The important aspect from the standpoint of medicine is its availability for study in the days to come. The Army has provided a central filing point for all negatives and prints at the Army Medical Museum, Washington, D. C. There will be much work to be done by the Museum in cataloging and filing the vast photographic treasure it will eventually possess.

Probably the most abundant type of photography has been that made in color. The improvement in sensitivity and keeping qualities of this form of record media has done much to influence the high quality results being obtained in most hospital laboratories. The extensive use of 4 x 5 inch color film in Speed Graphics and that of the 35-mm. size in the miniature cameras has accrued records of inestimable value to the military authorities and the medical profession.

Color photography has aided in the study of cases involving repeated surgical interference. Just as engineers photographically record the various stages of progress in construction so have surgeons recorded the progress in plastic repair of extremities that have been amputated, or the orthopedic restoration of fractured parts. The success or failure of surgical modeling of the stump to assure faithful fitting of a prosthesis, and the skillful rearrangement of muscle, bone and skin to accomplish this result is a matter of record. Also, the plastic repair of skin areas denuded by burns of various degree has been recorded extensively. In

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the more leisurely days of peace that lie before us, students and medical specialists will have much to draw from in the pictorial representation of every conceivable type of case.

The recording in still and motion pictures of the many neurosurgical cases that have resulted from war injury will do much to advance this type of surgery. The startling results obtained by nerve anastomoses will provide civilian practice with information concerning a means for restoring function to many of those injured in industrial or automobile accidents.

Infra-red photography seems to have some measure of value as an aid in making prognoses of nerve restimulation of circulation. The study of the superficial venous circulation in potential amputation cases of foot immersion, extremity gangrene of other types, and wounds of gunshot origin, will aid in establishing the level at which amputation would be most favorably accomplished.

Progress photographs have comprised the bulk of the photographic records. The convalescent phase of recovery has provided unsual opportunities to study trauma and therapeutic response. Photographic records of the returning or reestablishment of function of orthopedic or amputee cases, the color changes of skin manifested by some of the tropical diseases and, of course, the many dermatological situations that are a natural concomittant to the unusual environmental states to which many of the armed forces were subjected will undoubtedly be extensively reviewed.

Material obtained at necropsies, when death was due to tropical diseases, has been photographed in many forms and should provide an excellent source of information for research purposes.

The wealth of photomicrographs of histologic preparations, particularly in color, depicting many aspects of parisitology, blood-borne diseases of obscure origin, and the usual tissues found in civil practice, etc., should also be stimulating to the research worker.

Motion pictures are recording the numerous phases of the reconditioning program that serves so admirably in restoring the convalescent to physical independence and mental normalcy. The remedial exercises that restore function to injured parts and the general conditioning program employed to improve over-all physical efficiency as recorded, will be a medical boon to those agencies who are keenly interested in comparable civilian situations. The insurance companies, workmen's compensation boards, sanitoria, etc., will be able to employ reconditioning methods in shortening the duration of convalescence and make possible the early restoration of patients to their jobs and homes.

Reconditioning methods as worked out on such an enormous scale by the military cannot help but be an answer in the elimination of the

lengthy convalescence that is physically and mentally debilitating. The efficiency of planned exercise, whether remedial or general in the after-treatment of wounds and other injuries, has been conclusively established. And, from a military standpoint at least, the photographic record is the evidence.

Many medical photographers in the service have had to pinchhit by making photographs of patients and their activities for publication purposes. Such records have no medical value *per se* other than to provide information as to the nature of recreational activities enjoyed by the bed-patient and the convalescent.

Military medical photography will have its beneficial effect on the character of such work in civilian installations after demobilization. Men well trained in photography will eventually be affiliated with many hospitals and clinics. They will bring with them photographic skills that will later have major influence in the medical field. Physicians released from the services will have experienced the value of routine medical photography so often that they will be more than ever inclined to add photographic records to their clinical case summaries. Coming improvements in cameras, sensitive materials, and processing chemicals also will aid materially in stimulating the medical photographic field to greater expansion and usefulness.

The Journal Cover

The striking pattern which serves as the background of the cover is a photomicrograph of crystals formed by combining copper sulphate with calcium carbonate. Magnification approximately 900 diameters. The general arrangement of the cover was designed by your editor with the help of Nat Horton. The letters BPA on the cover take on an important role since the association is contemplating the conferring of fellowships. The reader will thus associate the letters BPA with our association. This design will be used in the four issues of Volume 14 with a change in the color of each issue. The plan is to have members submit photomicrographs, or a spread of plant life photographs, or a group of operating room shots, in fact any subject matter which illustrates a phase of biological photography, to serve as the background of the cover. Material for the next series of covers may be submitted to the editor at any time.

American Standards Association Notes

In the preparation of the American Standard Dimensions for Professional Portrait and Commercial Sheet Film (Inch Sizes) (Z38.1.28—1944) the subcommittee in charge recognized a difficulty often encountered in practice—that of a lack of fit between the sheet film and the film holder. Quoting from the foreword of the above standard:

> In the matter of relating film dimensions systematically to the nominal sizes, the committee encountered one significant difficulty because of the historical background of sheet films. When they were first introduced as replacement material for photographic glass plates, "sheaths" or "kits" were provided by the film manufacturers to permit the use of sheet films in plate holders. These holders normally accommodated glass plates of approximately full nominal size, but the "sheaths" or "kits" naturally encroached somewhat on this area in the plate holder because of the thickness of the material used for them, and thus required the films to be cut considerably below the nominal dimension. Moreover, no attempt seems to have been made to correlate the different sheath sizes, and so there is no uniformity in the deviation from the nominal in the films smaller than 11 x 14.

In the above standard the nominal size of 5 x 7 has for its normal size 4 60/64 x 6 60/64, with a minimum of 4 59/64 x 6 58/64, and a maximum of 4 61/64 x 6 62/64—all dimensions being in inches. In practice the actual size of a sheet of film will depend somewhat upon the ambient relative humidity.

Subcommittee 1 of Z38 (Physical Dimensions of Sensitive Materials) has under consideration proposed dimensions for photographic film holders of the lock rib type, and possible revision of the dimensions of sheet films. When a standard for film holder dimensions is adopted there should be no further difficulty in loading film holders of recent manufacture with any standard brand of sheet film.

LOUIS PAUL FLORY
Yonkers, N.Y.
B.P.A. Representative

Journals Needed

The editorial office of the Biological Photographic Association, Marquette University School of Medicine, Milwaukee 3, Wisconsin, will purchase copies in good condition of this journal, Volume 13, Number 1, September 1944 at seventy-five cents apiece.

CURRENT PHOTOGRAPHIC ABSTRACTS

Fluorescent Staining of Insect Tissues. C. T. Brues. *Science,* 100: 554-55, Dec. 15, 1944. The differential staining of microscope specimens, especially insect tissues, by fluorochromes is discussed. Fluorescence is usually most strongly activated by the longer wavelength of ultraviolet, especially those near λ 365 *mu*. The fluorochromes stain at very great dilutions from aqueous solution after the section has been immersed for a half an hour or longer, and preparations commonly retain their fluorescent properties for many days, provided they are stored in a dim light. A near-by neutral solution seems to be universally most satisfactory. Ordinary balsam or other mounting medium must be replaced by one which does not fluoresce, such as glycerine. For the same reason, not all oil-immersion objectives can be used because of the natural blue fluorescence of immersion oil. The author reports that certain specific alkaloids obtained from extraction of several plants found in the United States. e.g., berberine, which is found in common horticultural forms of barberry, act as powerful yellow fluorochromes. These fluoresce more powerfully than the acridine and flavine types of dyes which are sometimes recommended as fluorochromes. Not all of the highly fluorescent alkaloids tried, however, were found to be efficient fluorochromes.

R.P.L.

Critical Miniature Photomicrography. R. S. Allan. *Phot. J.,* 84: 13-17, January, 1944. The author discusses first low-power photomicrography with the miniature enlarger, and then miniature camera photomicrography, using high-resolution, e.g., "Microfile," film. With this film, although exposure for a full range of gradation is critical, the resolution is such that the negatives can be enlarged 10 diameters before reaching the resolving power of the eye.

C.H.S.

State University Makes Films and Teaches Schools How Best to Use Them. B. E. Mahan. *Educational Screen,* 26:438, December, 1944. The Bureau of Visual Instruction of the University of Iowa Extension Division has long operated a lending library. It handles 3000 reels on about 1500 subjects, and the number continues to increase. The Bureau has also served as a film producer for at least seven departments of the University. The Bureau furnishes advice and practical training in making motion-picture films to teachers in the state. State conferences in five cities were held for teachers and administrators to promote greater interest in the use of films. Demonstration lessons were taught in each city with fifteen boys and girls from the fifth or sixth grade.

E.P.W.

Kodachrome Photomicrography in Malaria. H. M. Maveety, R. B. Turnbull, and C. R. Bauer. *U. S. Naval Med. Bull.,* 44: 134-41, January, 1945. Since stained smears of the malaria parasite fade quickly, the authors suggest making Kodachrome slides of fresh preparations and using the slides for teaching purposes. In the setup described, a modified Giemsa stain was used. A Leica

camera was supported over the microscope by a wooden box. A Burton lamp was used containing an ordinary 100-watt projection bulb but with the green-absorbing light condenser replaced by a white one. Details of the arrangement and equipment are given: A concave mirror was used with the condenser, Kodachrome Type A film was used, and a magenta compensating filter was used to eliminate the greenish cast in the image plane.

R.P.L.

The Elements of Exposure. A. R. Greenleaf. *Amer. Phot.,* 39:8-13, February, 1945. The following conditions that affect filter factors are discussed: (1) the spectral characteristics of the light source; (2) the spectral transmission of the filter; (3) the spectral sensitivity of the emulsion; (4) the effective exposure given (including the effect of reciprocity-law failure); and (5) the development procedure. The various kinds of exposure meters and calculators are also discussed. Exposure meters are used in two ways: (1) to measure the light reflected by the object to be photographed; and (2) to measure the light incident upon the object photographed. In (1) either the light reflected by specific surfaces of the subject, for example, the brightest and darkest surfaces, or the average light reflected by the entire subject may be measured. Measurement of the incident light is thought to result in a higher proportion of acceptable negatives by an inexperienced photographer than measurement of the average reflected light. Exposure meters are classified under four headings: (1) actinometers; (2) extinction photometers; (3) comparison field photometers; and (4) photoelectric photometers. The use of each type is discussed, as is also the use of exposure tables.

M.W.S.

Rapid Processing of Photographic Materials. J. I. Crabtree and H. D. Russell. *J. Phot. Soc. Amer.,* 10:541-51, No. 9, November, 1944. Communication No. 990. Rapid processing of photographic materials requires that each step consume a minimum of time, as follows: (1) Development is most rapid in caustic solutions at high temperatures; (2) the rate of fixation is at a maximum in ammonium thiosulfate baths and at high temperatures; (3) rapid washing requires frequent renewal of the water layer in contact with the photographic material; and (4) drying may be accelerated by the use of alcohol baths. Washing and drying may be avoided by printing the negative wet or by the use of a special holder or a liquid cell. It is also possible to avoid printing entirely by iodizing the image or by converting it to a white image with a mercuric bleach. A summary of alternative rapid processing procedures is included.

Exploring the Insect World. *U. S. Camera,* 8: 36-7, 60, No. 1, February, 1945. A Russian entomologist, R. Vishniac, who specializes in photographic studies of insects, uses a long-range telescopic lens camera with a synchronized flash. A single-lens reflex camera with a mirror is used, the lens being camouflaged against sight and, by rubbing it with leaves, against smell. He ordinarily employs fast film and an exposure time of 1/25 second with an aperture of either *f*/18 or *f*/25. For illumination, he uses two flash-bulbs and occasionally a mirror to supplement sunlight. Further suggestions for photographing insects include: Observe the subject with the naked eye as well as with a magnifying glass before touching the camera. Try to photograph insects in their characteristic activities. Observe them in different seasons and at different times of day. Use only ordinary means, such as laying out bait, to get your picture. Several photographs of insects are reproduced.

M.W.

Association News

Medical Illustrators Meet in Chicago

We are indebted to our Honorary Member, Mr. Tom Jones for sending us the following information, in answer to our request for news of the organizational meeting held by medical illustrators at the Palmer House in Chicago, July 16-19, 1945:

The aims of the organization will be to "promote the study, and encourage the advancement of medical illustration and allied fields of visual education; to promote understanding and cooperation with the medical and dental professions, including public health and nursing; and to advance medical education."

The officers elected were: *President,* Tom Jones, University of Illinois, Chicago, Illinois; *Vice President,* W. C. Shepard, of the W. B. Saunders Publishing Co., Philadelphia, Pa.; *Secretary,* Muriel McLatchie, Massachusetts General Hospital, Boston, Mass.; *Treasurer,* Elizabeth Brodel, New York, N.Y.; *Chairman of Board of Governors*: Elon Clark, Duke University, Durham, North Carolina.

Guest speakers at the dinner which took place on July 17 included Dr. Eben J. Carey, Dean of the Marquette University, School of Medicine; Dr. Morris Fishbein, Editor of the Journal of the American Medical Association; Dr. Carl Hartman, Professor of Zoology, University of Illinois; Dr. Thomas Hull, Director of Scientific Exhibits, American Medical Association; Dr. Malcolm MacEachern, Associate Director, American College of Surgeons; and Dr. Fred Zapffe, Secretary, Association of Americal Medical Colleges.

The Association of Medical Illustrators begins with a charter membership of approximately fifty-four. The first general meeting will probably be held in Philadelphia in 1946.

All B.P.A. Authors, Please Note!

If you order reprints of your articles for our Journal, we would greatly appreciate your sending at least one copy (preferably two) to the Secretary, Miss Anne Shiras, Magee Hospital, Pittsburgh 13, Pa. We have many requests for help; and Journal articles, grouped to fit individual needs, are an invaluable loan to the members and institutions who send in questions.

No matter what the date, if you have reprints that you have not already sent in to us, we would greatly appreciate your sending them now. Many articles which appeared in our early volumes are still of value; in fact some of our most experienced members wrote up their

technic for our first numbers. This request holds good for all who have been, are, or may in the future be contributors to our Journal!

Materials Available for Visual Instruction from the Society of American Bacteriologists

Besides abstracts on motion picture films, each containing a resume of a film and information about its distribution (cf. Motion Picture Committee's Report, J. Biol. Photgr. Assoc., 1944, 12:189) Dr. Harry E. Morton of the University of Pennsylvania, School of Medicine, Philadelphia 4, Pa. announces that the Committee on Materials for Visual Instruction of the Society of American Bacteriologists has 125 negatives, either originals or duplicates, of subjects in the field of bacteriology, and from these is prepared to furnish the following:

(1) lantern slides, 3¼ x 4 inches, $1 each
(2) lantern slides, 2 x 2 inches, glass mount, $0.65 each
(3) lantern slides, 2 x 2 inches, cardboard mount, $0.50 each
(4) black and white prints, 8 x 10 inches, $0.50 each
5 x 7 inches, $0.35 each

Standard size lantern slides, 3¼ x 4 inches, may be rented at the rate of 25 cents for 1 week, in addition to paying transportation charges both ways and any damage to the slides.

The subjects include 20 photographs having to do with droplet sprays from coughs or sneezes, photographed by stroboscopic light; 5 photographs of various types of electron microscopes and their optics; and 100 photomicrographs of bacteria and viruses, made with the electron microscope.

Markets for Nature Photographs

From time to time the B.P.A. receives requests from authors or publishers for illustrations of various kinds. Since the Association has no photographs for sale, the most we can do is to refer such inquiries to members who work in the desired fields. Transactions from then on are strictly between the buyer and individual members.

Recently a request has come from Frank W. Lane, F.Z.S., Chipperfield, 116 Evelyn Avenue, Ruislip, Middx, England. Mr. Lane is a writer on natural history, and desires color prints and transparencies of birds, insects, fish, mammals and reptiles. The transparencies should preferably be in the cut film sizes; at least 3x 2 inches, or over. He also wants black-and-white prints of striking nature shots such as animals in rapid action, snakes striking and predators seizing their

prey; pictures of experiments in which animals are used; photographs showing the development of a chick in the egg; animals or birds perching or riding on each other's backs, etc., etc.

Another request has been received from L. Jacobi, Publix Pictorial Service for full-size Kodachromes showing sea-animals like the octopus, sea-roses, etc. taken under water in an aquarium. These pictures are needed for a national magazine, which wants production rights only. The pictures will be paid for at the regular rates, will be credited to the photographer and will be returned in good shape after the plates are made.

Any members interested in selling pictures of the above types should get in touch directly with the purchasers.

Scientific Photography in England and Scotland

The Association for Scientific Photography in England has formed a Medical Group, with Flt. Lt. H. Mandiwall, M.B., B.S., L.D.S., F.R.P.S., as Chairman. Flt. Lt. Mandiwall, who recently became a member of the B.P.A. writes that he addressed the new group on "Visual Education in Medicine."

The Association for Scientific Photography has not been able to publish a Journal, owing to restrictions on printing paper. However, the papers, presented at their meetings are circulated in mimeographed form. To show the general range of subjects considered at their meetings, a list of mimeographed papers recently received by your secretary is given below:

"The Kodatron Speedlamp." G. A. Jones, Research Laboratories, Messrs. Kodak, Ltd.

"Materials for Scientific Photography." H. Baines, D.Sc., F.I.C., Pres. R.P.S., and F. J. Tritton, B.Sc., F.I.C., F.I.B.P., F.R.P.S.

"An Experimental Approach to Time Lapse Cinematography." J. H. Ridley, A.R.P.S.

"A Consideration of the Requirements for Micrography and Cinemicrography Apparatus." E. Mackie, F.R.M.S., F.Z.S.

"Electric Discharge Lamps." H. K. Bourne, M.I.E.E., A.R.P.S., (Messrs. The British Thomson-Houston Co., Ltd. Research Laboratory.)

"The Production of Scientific Films for Biological and Medical Purposes (on 16mm. film stock)." Dr. J. Yule Bogue, M.R.C.V.S. President of the Association for Scientific Photography.

"Kinemicrography in Biological Research." R. McV. Weston, M.A., F.R.M.S., A.R.P.S.

Miss Sylvia Treadgold, a member of the Association for Scientific Photography who does the photography at Guy's Hospital in London, also recently joined the B.P.A. Photographers in this country who suffer because their laboratories are not the last word in convenience might give a thought now and again to Miss Treadgold's. Her studio is the only habitable room left on the top floor of Guy's, owing to past blitzes. A bomb that fell in the middle of the block demolished the staircase from top to bottom and put both lifts out of commission. One lift is working again but can only negotiate a few floors. By the time Miss Treadgold's patients have climbed the rest of the way she says they are glad for a "nice sit down." Her work includes pictures of before-and-after records of plastic surgery, many of the cases being air-raid casualties; dermatitis and orthopedic cases, dental patients, and some records for criminal investigative work. She takes most of her color pictures on Dufay film. Kodachrome takes two months to be processed and can only be obtained in 35mm. size. Since miniature cameras are practically unobtainable and never appear in the open market, use of that film is limited to the few who have the right equipment. Her studio is a large room with a small north light and a little dark-room. Plans for the rebuilding of Guy's include a much larger studio, with room for a staff of 3 or more. At present Miss Treadgold does all the photography; is her own cleaner and bottle-washer since help is impossible to get; and gives the radiography students a course in photography in the bargain!

Another interesting letter has come from Alastair Atkinson, of Clackmannanshire, Scotland, who joined the B.P.A. in 1943. Mr. Atkinson teaches biology in the Junior Secondary School where there is little scope or equipment to do much biological photography at present. However he says his county, the smallest by far in Scotland, is well equipped with motion picture projectors, which are constantly in use. Before the war, there was much interest in film strips, and this will probably increase if the very good strips made for teaching the armed forces are released. It is interesting that the local branch of the Scottish Educational Film Association has been using the projectors presented to the Board of Education by the United States Government, together with film strips of American life. Mr. Atkinson says these films have made a deep impression, and he believes the pictures will do a real job of interpreting true American life to Scottish children. As to motion picture films, a film library was set up in Glasgow around 1938 with the help of a grant from the Carnegie Trustees. The copies are all well-worn now, few if any having been replaced since. Film is so tightly restricted that only a few educational pictures can be made. Apparatus too, is at a premium. Only second-hand equipment has appeared on

the market for a long time. Prices are at about twice or three times their pre-war values. The few new gadgets obtainable carry a purchase tax as high as 100%. Nevertheless interest in visual education seems to be keen. Mr. Atkinson has maintained his enthusiasm through all the difficulties, and says that he always looks forward very much to the arrival of the B.P.A. Journal.

Salon Announced

The following announcement was just received from Frank Fenner Jr., Chicago, Illinois, chairman of the Publicity committee.

Name: Fifth Chicago International Salon of Photography
Exhibit: January 20 to February 22, 1946
Place: Chicago Historical Society
Closing Date: January 9, 1946
Entry Fee: $1.00
Entries: Not more than FOUR prints
Entry Blanks: Obtainable on request from

The Chicago Historical Society
Clark Street at North Avenue
Chicago 14, Illinois

Jury of Selection: To be announced later

The Salon will be conducted according to the recommended practices of the Photographic Society of America.

B.P.A. Officers and Committee Chairmen

President	Ferdinand R. Harding The Children's Hospital Boston 15, Mass.
Vice President	Stanley J. McComb Section of Photography Mayo Clinic Rochester, Minn.
Secretary	Anne Shiras University Office Magee Hospital Pittsburgh 13, Pa.

Treasurer	Stella Zimmer Photographic Department School of Medicine Syracuse University Syracuse 10, N.Y.

Editor of Journal	Leo Massopust Marquette University Milwaukee 3, Wis.
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Public Relations Committee	Dr. Arthur W. Proetz 1010 Beaumont Building St. Louis 8, Missouri
Committee for Cooperation with the Army	Major Ralph P. Creer Army Medical Museum Washington 25, D.C.
Traveling Salon	Louis Schmidt Rockefeller Institute New York 21, N.Y.
Salon Chairman	Nathan S. Horton 32nd floor, 22 E. 40th St. New York 16, N.Y.
Questionnaire Chairman	Arthur L. Smith Photographic Science Serv. Cornell University, Ithaca, N.Y.
Curriculum Chairman	Stanley J. McComb Mayo Clinic Rochester, Minn.
1945 Convention Chairman	Joseph B. Haulenbeek Rockefeller Institute New York 21, N.Y.

Sustaining Members

Some individuals have a deep interest in the advance of scientific photography help finance a wider range of activities for the Association by becoming Sustaining Members.

Bell, Dr. Dennistoun M.
"Broadview"
Amagansett, N.Y.

Brubaker, J. D.
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Chicago 26, Ill.

Davidson, Emil
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New York 10, N.Y.

Elder, George S.
U.S.S. Sevier
c/o Fleet P.O., N.Y.

Flory, Louis Paul
Boyce Thompson Institute
for Plant Research
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Yonkers 2, N.Y.

Garner, Dr. Jay M.
723 Elm Street
Winnetka, Ill.

Gravesen, Lt. Alex A.
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River Edge Manor, N.J.

Gibson, H. Lou
Eastman Kodak Company
343 State Street
Rochester 4, N.Y.

Hagaman, R. S.
Defender Photo Supply Co.
Rochester 3, N.Y.

Hill, Thos. T.
Edwal Laboratories, Inc.
732 Federal St.
Chicago 5, Ill.

Horton, Nathan S.
Ayerst, McKenna & Harrison, Ltd.
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New York 16, N.Y.

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1700 Standard Building
Cleveland 1, Ohio

Lester, Henry M.
101 Park Avenue
New York 17, N.Y.

Proetz, Dr. Arthur W.
1010 Beaumont Bldg.
St. Louis 8, Mo.

Schubert, W. J.
Fairchild Camera & Instrument Co.
475—10th Ave.
New York 18, N.Y.

Semken, Dr. George H.
16 West 85th Street
New York, N.Y.

Shiras, Miss Anne
University Office
Magee Hospital
Pittsburgh 13, Pa.

Smith, James
1721 Bushnell Avenue
S. Pasadena, Calif.

Varden, Lloyd E.
Pavelle Laboratories
533 West 57th Street
New York, N.Y.

Zbinden, Theodore
412 Colton Building
Toledo 2, Ohio

"I can make a better Microscope"

Professor Gilman was startled by the statement of his guest, Charles A. Spencer. He had been exhibiting his prize possession—a microscope made by Chevalier of Paris.

That was in the fall of 1846. Often during the following months, Dr. Gilman, a professor in the College of Physicians and Surgeons, New York, amused his friends with the story of the presumptuous backwoodsman who challenged the leading optician of France.

Six months later Spencer presented two objectives to the Professor.

Gilman placed them on his microscope and studied specimen after specimen. At last, bursting with excitement, he gave his verdict: "Why these are excellent! How did you do it?"

Charles Spencer took home to Canastota, New York, the first order ever given to an American for the manufacture of a microscope.

In another six months (October, 1847) the microscope was completed. On his way to deliver it, Spencer stopped at West Point to have the instrument tested by Professor J. W. Bailey, "father of microscopic research in America." Bailey was enthusiastic, acclaimed it "decidedly superior to Chevalier's," and added that it was at least equal to the Lowell instrument at Boston.

Thus Charles A. Spencer, self-taught and with only the experience gained in his homemade workshop, took his place beside the most experienced opticians of Europe.

Today, nearly a century later, the name Spencer is the hallmark of highest quality in scientific instruments. Research insures the perpetuation of the Spencer ideal.

American Optical
COMPANY
Scientific Instrument Division
Buffalo 11, New York

Manufacturers of **SPENCER** *Scientific Instruments*

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O 1945
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Leo C. Massopust, Editor

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12a

Coated Lenses for Biological Photography

Lorus J. Milne†

Introduction

Of the many technological advances which wartime research and development have brought to the fore, none are more significant to the biological photographer than the coating of lens and prism faces with low reflectance films. Commercial availability of coated lenses actually preceded the war (1939), but improved technics and quantity production of completely treated optical systems have been intimately related to our war equipment needs.

Through his war research work, the writer became familiar with a number of the procedures used in applying low reflectance films to optical surfaces. Additional experience was gained in the use of devices with fully treated lenses and prisms. Recently, through the courtesy of the Bausch & Lomb Optical Company of Rochester, otherwise identical pairs of photographic lenses were made available to the author, with which to investigate whatever improvements the coatings made in biological photography. These comparison lenses were a pair of Bausch & Lomb Tessars Ic, 168 mm focal length, f.4.5 aperture, and a pair of Bausch & Lomb Micro Tessars, 48 mm focal length, f.4.5 aperture. Both were used on a 4 x 5 view camera.

The Principles of Low Reflectance Coatings

Low reflectance films are extremely thin sheets of special materials applied to optical surfaces to increase transmission of light. They function by reducing light loss through reflection from polished faces, redistributing this energy so that a higher percentage of incident light is transmitted, the efficiency of the optical system improved and the quality of images bettered. For the photographer the advantages are threefold:

Presented at the meeting of the Biological Photographic Association, September 13, 1945, New York, N. Y.

† 214 Highland Avenue, Jenkintown, Pa.,

Legend for Frontispiece

Figure 12. Long horned grasshopper illuminated by a single No. 2 photoflood bulb in reflector at 18 inch distance, the light angle adjusted to give bright highlights on the fine veins of the green wings. Lenses and film as in figures 6-9; exposures and iris openings the same in the comparison pair of pictures. The coated lens, b, caught the highlights, while these were lost entirely by the untreated Tessar, a.

(1) a coated lens produces a sharper image with better contrast, (2) its effective aperture is increased because the coated lens transmits a higher percentage of light through any given iris opening, and (3) photographs

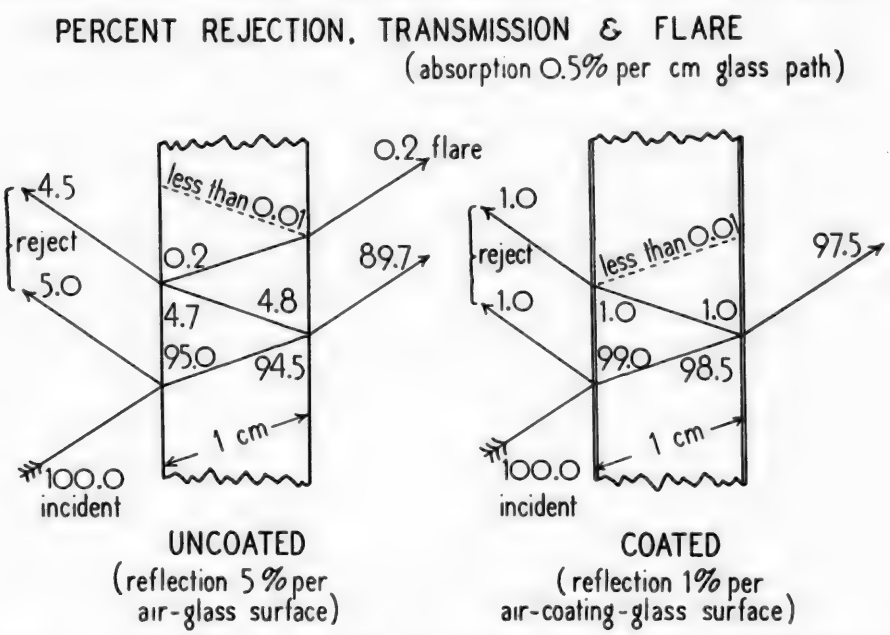


Figure 1. Comparison of uncoated and coated plates of glass in terms of percent rejection, transmission and flare.

may be taken into subjects with extremely bright backlighting, even without a sunshade, with far more satisfactory results.

To understand the action of low reflectance films, it is simplest to consider first a plane sheet of glass through which a light beam is passed, figure 1. Depending on the kind of glass, anywhere from 4 per cent to 6 per cent of the light is reflected away without ever entering the glass. Five percent is a good average figure for such loss from the "first surface" if we consider only light meeting it at almost perpendicular, "normal" incidence. Of the 95 per cent which does enter the glass, about 0.5 per cent is absorbed per centimeter thickness, energy expended in warming the glass molecules. If our glass plate is a centimeter thick (about 7/16 inch) in the direction taken by the light ray, the 95 per cent will drop to at most 94.5 per cent before the second surface is reached. The second surface will reflect another 5 per cent of the 94.5 per cent (i.e. 4.8 per cent) back into the glass toward the first surface, leaving only 89.7 per cent of the original beam to proceed without further alteration. The 4.8 per cent reflected by the second surface will be absorbed slightly by the glass itself, and either escape (95 per cent of it)

into the air, or be reflected back again through the glass. Summing up the series of reflections yields the values given for the various beams in figure 1.

If the incident light strikes the glass plate exactly at right angles, there will be no appreciable spread in the transmitted beam as long as the glass surfaces are scrupulously clean. At any other angle, however, the doubly reflected transmitted light forms a flare pattern to one side of the main beam, a "ghost" in the language of lens designers. Although with a plane sheet of glass this ghost may be as pale as 0.2 per cent of the incident light, a series of plates produces a cumulative effect. Similarly a series of lenses such as comprise most photographic optics accumulates enough flare light to destroy much contrast.

The photographic picture is affected in two ways by the 9.5 per cent light loss per pair of air-glass surfaces. On the outside of the camera, this represents light which might have formed an image had it been

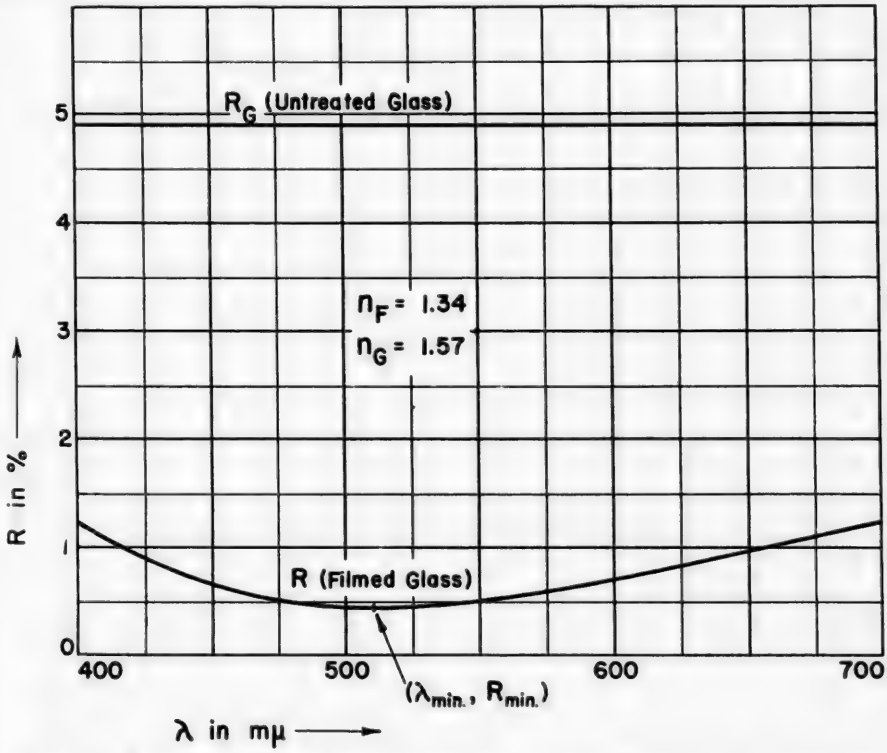


Figure 2. Relationship between wavelength (λ) in millimicra and reflectance (R) in percent, for coated glass through the visible range of the spectrum. Thickness of film on two surfaces of plate adjusted to give minimal reflection at 510 mμ, and smallest total reflectance in the visible range. Illustration by courtesy of the Bausch & Lomb Optical Company.

able to reach the film—this is a matter of the "speed" of the lens. On the inside of the camera, it represents a major flaw in camera engineering. Camera designers carefully blacken the inside of the bellows, etc., so that light reflected from the yellow emulsion will not bounce around

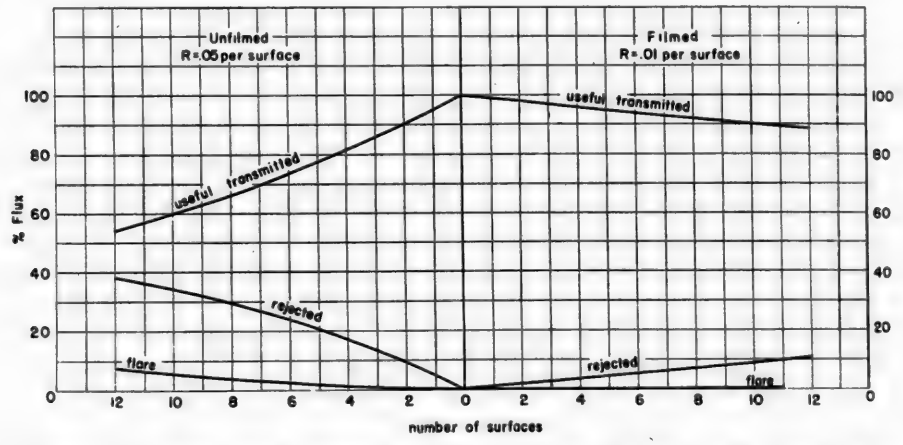


Figure 3. Comparison of uncoated and coated plates of glass as in figure 1, but for a range of total surfaces. Illustration by courtesy of the Bausch & Lomb Optical Company.

inside the camera and return to the sensitive film. But an uncoated lens is a fairly good mirror, to reflect such emulsion light back where it can fog the picture. This is "veiling" light or flare or ghosts, depending on the distribution taken by the returning light. Thus to reduce the 9.5 per cent loss per pair of air-glass surfaces becomes doubly important in photographic lens systems.

Low reflectance films have optical characteristics (index of refraction most important) as nearly as possible the harmonic mean between those of air and those of glass. In this way, incident light will be reflected in about equal amounts by the two surfaces of the coating, the air-film surface and the film-glass surface[1]. By adjusting the thickness of the coating with great precision, the light waves of these two reflected beams can be made "out of phase" for any given wavelength. Two beams of light completely out of phase (a half wavelength lag or gain) obliterate one another, like adding equal positive and negative quantities, while beams of light which are "in phase" reinforce one another and increase the joint energy content. If the coating applied to our glass plate has a thickness of one quarter wavelength of green light (about 0.000,-

[1] If n_f be the refractive index of the film, n_g that of the glass, and n_a that of air, the reflection from the air-film surface is approximately proportional to the ratio n_a/n_f. That from the film-glass surface is given roughly by the ratio n_f/n_g. For equal reflection from these two surfaces, n_a/n_f should equal n_f/n_g, or $(n_f)^2=n_a.n_g$. But $n_a=1.00$. Hence for the ideal case of equal reflection, n_f must equal $\sqrt{n_g}$. Although approximate, these values are close enough for practical use.

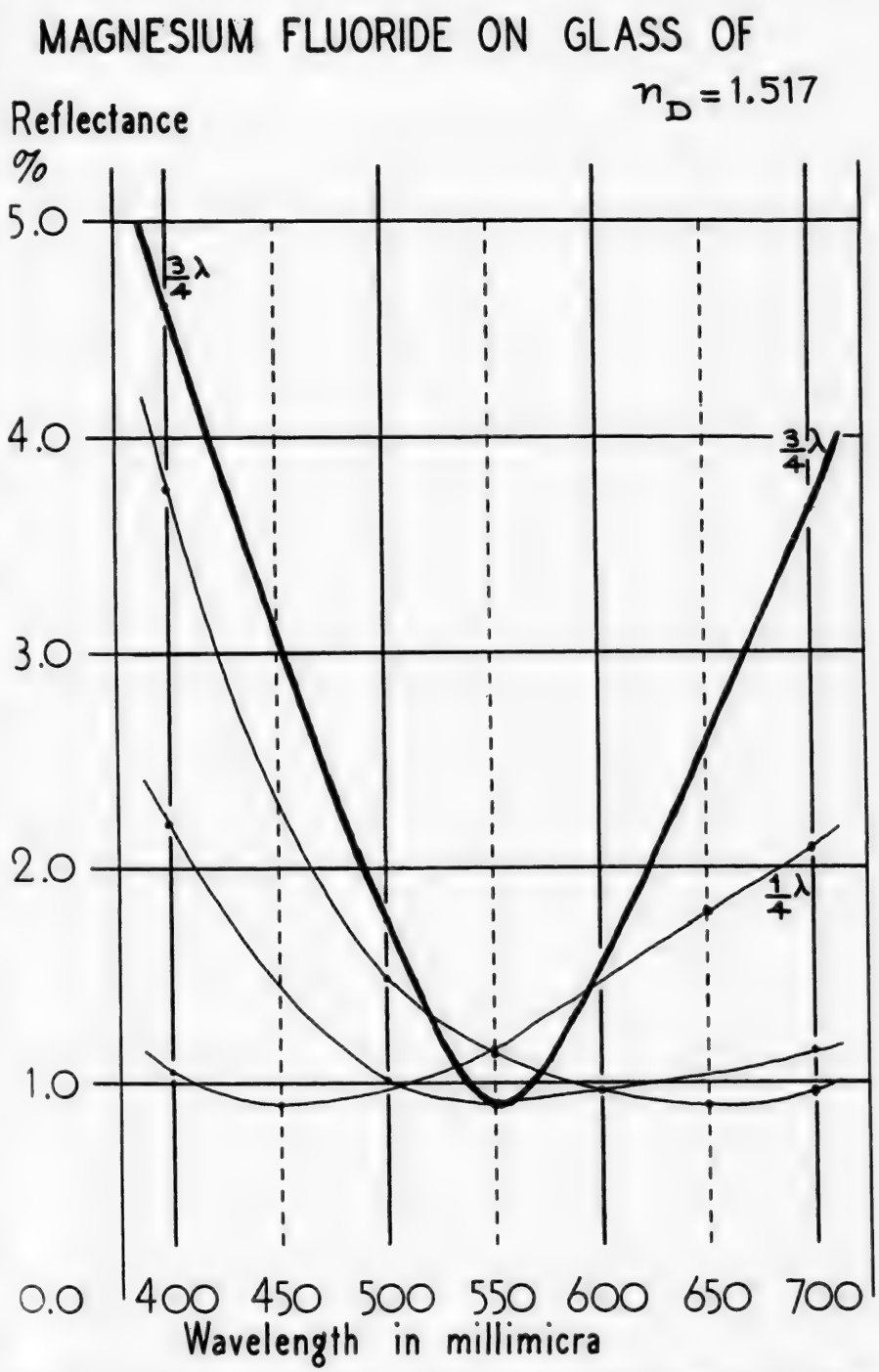


Figure 4. Comparison of quarter wave films having minimal reflectance at 450, 550 and 650 mμ, and a ¾ wave film with minimum at 550, in the same terms as figure 2.

004 inches[2]), such light reflected normally from the film-glass surface will be two quarters of a wavelength (i.e. ½ wavelength) behind similar light reflected from the air-film surface, and the two will cancel out. Wavelengths of not too different dimensions will be partially obliterated, the effect falling off as either end of the visible spectrum is approached.

But light is energy and cannot be destroyed by this or any other means. With the surface coating, not only the prevention of reflection is accomplished. It causes a redistribution of the light energy to augment the transmitted beam. In figure 1, for comparison with the plain plate of glass, is a coated sheet, to show the altered percentages of transmission and reflection with the best coatings. The relationship between wavelength (λ) and reflectance is shown in figure 2 for a plate of glass having both surfaces coated for minimal reflection at 510 millimicra. This coating gives the least total reflection in the visible range.

Few optical systems have only a single pair of glass-air surfaces. Figure 3 gives comparative values of reflective losses, flare and transmission for a considerable range of total surfaces, both untreated and coated. These values are based on plane plates but apply approximately to curved surfaces as well.

Production of Low Reflectance Coatings

For many years, a little understood paradox has been familiar to some photographers in the fact that old lenses not only may acquire a bluish or purplish tarnish, but that such lenses are actually "faster" than an untarnished, new lens of identical construction. In 1892, H. Dennis Taylor investigated this tarnish on flint glass. Actually it was a low reflectance film formed in the glass surface by atmospheric corrosion. Some kinds of glass are more susceptible to this than others, and in many the tarnish is accompanied by other changes which may ruin the optics entirely.

Chemical treatment of optical surfaces has been tried in many ways. Perhaps the simplest and most obvious was to expose lens and prism faces to fumes of hydrofluoric acid, etching the glass to a controlled depth. An artificial tarnish may be produced in this way, and transmission increased. However, the submicroscopic pits and honeycombing of the glass surfaces pick up grease and other materials, which fill the spaces and "poison" the surface, reducing the advantages gained by treatment. Such etched optical surfaces are extremely difficult to clean, and should never be placed where they can receive dust, dirt or grease.

Various solutions have been prepared for direct application to lenses and prisms in different ways. Ideally they should be as transparent as

[2] Because of the higher refractive index of the film, a quarter wave in the coating is shorter than one in air. The latter is about 5.4×10^{19} inches.

glass, have a constant refractive index in the chosen range, and be tightly adherent as well as very abrasion resistant. Some of the liquids prepared are sprayed on with equipment much like an airbrush for paint. Others are intended for immersion of the optical part, followed by slow and controlled withdrawal with correspondingly slow and controlled drying. In both of these methods, it is difficult to apply an even coating of specified thickness. Another and more ingenious system requires a jig

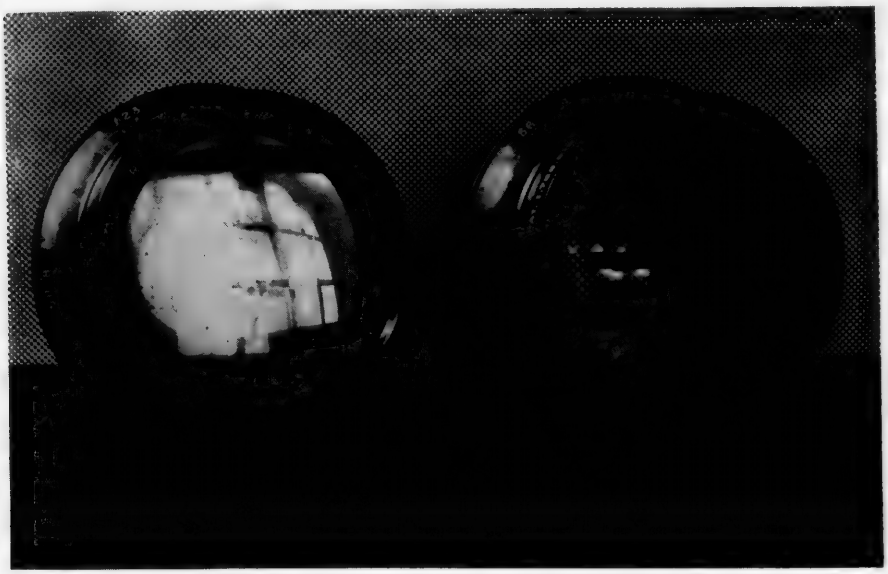


Figure 5. Bausch & Lomb 100 mm f.2.3 Baltar lenses, the left one uncoated, the right one "Balcoted" and showing difference in reflection from surfaces. Note checkerboard pattern seen through right lens, also details of iris diaphragm leaves. Illustration by courtesy of the Bausch & Lomb Optical Co.

to hold the lens or prism, revolving on its axis at high speeds while drops of solution are added to the center of rotation. Centrifugal force spreads the drops with remarkable uniformity and the solution is added until the required thickness of film has been built up. Most films produced from solutions are of poor durability, wearing off when the lenses are cleaned. Some have the further disadvantage of scattering light or fluorescing. Collectively these methods are termed "cold coating."

The most satisfactory method in current use is to evaporate films of calcium fluoride (fluorite) or magnesium fluoride (sellaite) through the use of heat and high vacuum (of the order of 10^{-5} mm of mercury). These transparent films have refractive indices slightly less than 1.30[3] and 1.40 respectively, compared to 1.00

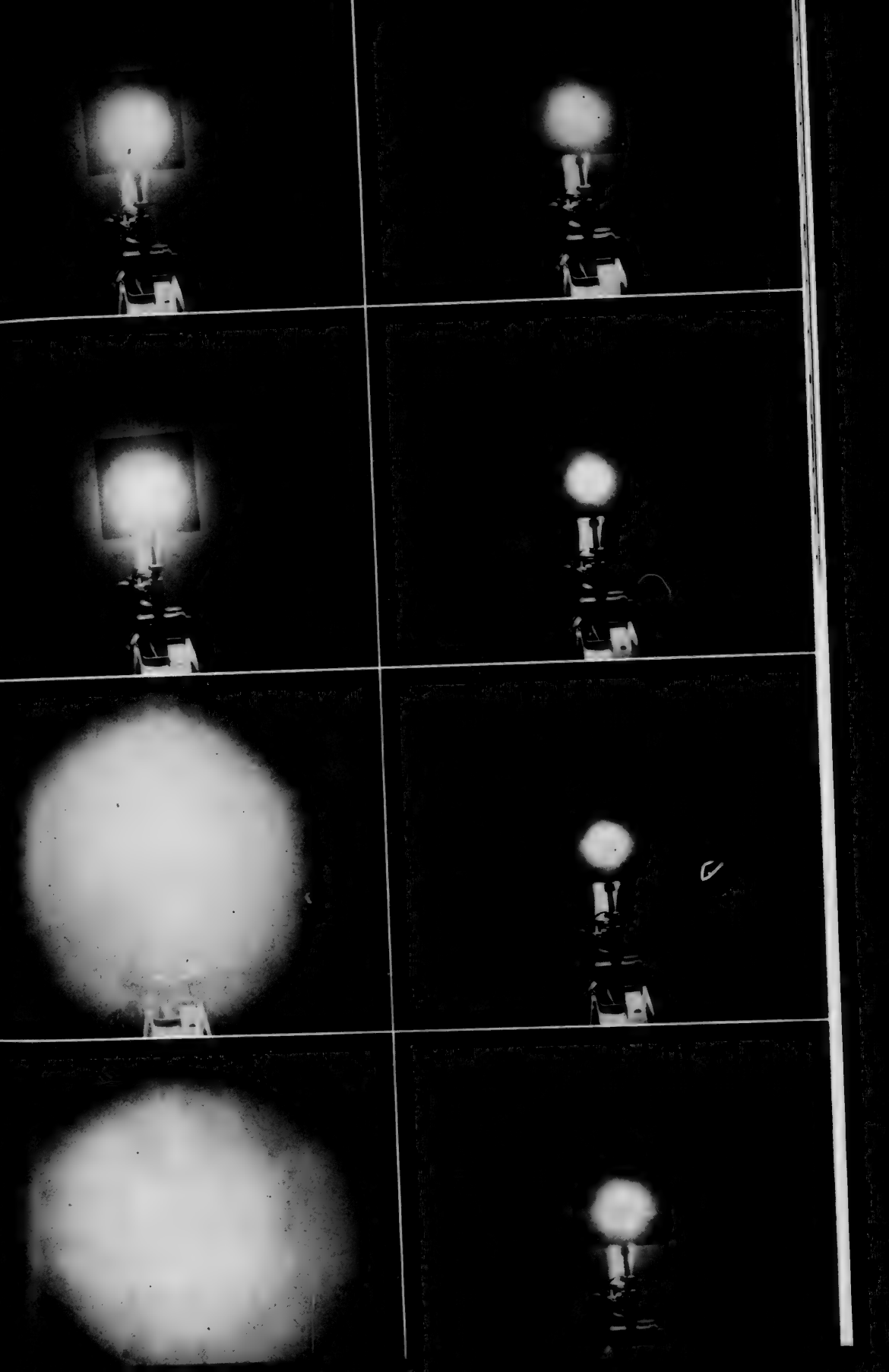
[3] Large amounts of calcium fluoride have a refractive index of 1.43, but the substance acts anomalously in thin films, in having a much lower value of n.

for air and 1.52 to 1.66 for optical glasses. Under the conditions of heat and high vacuum, the evaporating fluoride travels at high velocity through the bell jar and condenses on the optical surfaces placed in its path. Since the evaporation of the fluoride is controlled by an electric heater element, the process may be stopped as desired. In practice it takes almost an hour to evacuate the bell jar containing the optics and special equipment, and about five minutes to develop a satisfactory coating.

The end point in coating is chosen by studying the color of light reflected from the treated surface. Before the film is applied, the reflection from a white source is a white image, since glass reflects all visible wavelengths uniformly. As the coating builds up, it becomes thick enough to interfere with reflection of the shortest wavelengths (blue light) and only the remainder of the spectrum reaches the eye to be recognized as a yellowish reflection. As the film becomes thicker, it removes the green and some blue begins to reflect again, giving a reflected appearance of brownish to purplish. If the process is not stopped, the film becomes thick enough to interfere with the long red waves, and to interfere still less with blue and less with green, so that the white source is seen as a blue reflected image. Figure 4 shows the reflectance of films with minimal values at 450 millimicra (blue), 550 (green) and 650 (red). Continued evaporation brings the film to a thickness which will be reflecting again for all visible wavelengths, followed by a repetition of the sequence just described as the coating becomes ¾ of a wavelength thick, rather than ¼ as wanted. Such a ¾ wave film for minimum at 550 mμ is shown also in figure 4. Untreated glass would be represented by the horizontal 5 per cent line.

Details of technic and criteria for end points differ, and each organization coating optical surfaces protects its particular procedures with a trade name. Thus the Bausch & Lomb Optical Company terms its product "Balcote" and strives continually to improve its qualities. Currently the Balcote surface film has approximately as much resistance to mechanical damage and chemical action as have the optical glasses of which prisms and lenses are made. Its effectiveness in reducing surface reflections and losses from the transmitted beam is more spectacular in optical

Figures 6-9. Comparison photographs taken with uncoated and "Balcoted" 168 mm Tessar Ic lenses, each pair exposed identically and all processed exactly alike. Figures 6 and 7 were 1/50 sec. at f.4.5, and figures 8 and 9 were 1 sec. at f.32. Figures 6 and 8 were with the light source on the axis of the lens; in figures 7 and 9 the source was 1 degrees 9 minutes off the axis to the left. All pictures on Kodak Super Panchro Press Type B (antihalation) processed in D-76 for 13 min. at 72 F. Enlargements for all figures were made through the Balcoted Tessar. all prints on identical emulsion with identical exposures. All differences are due thus to the "taking" lens.



systems with many air-glass surfaces. Figure 5 shows two Bausch & Lomb 100 mm Baltars, one uncoated, the other treated. In the latter, light from the checkerboard background can be seen plainly, as well as details of the iris diaphragm leaves, while in the Baltar without coatings, these details are masked by reflections from the lens surfaces. Even in a 6-surface lens such as a Tessar, measurements show that the untreated lens transmits 74 per cent of incident light while a coated one transmits 91 per cent, an increase of 17 per cent toward perfection, and an improvement of 23 per cent over the plain Tessar.

Coatings and Photography

An increase in transmission of 23 per cent is considerably less than half a stop, an increase in lens speed which is negligible under most photographic conditions. Color film has such a narrow latitude at present that for critical work in this medium even 23 per cent may become significant. However, press and war photographers often work beyond the limits of reasonable underexposure, as for example catching action under foliage during a steady rain, especially taking such shots from low angles for effect or personal safety. To such cameramen, the 23 per cent extra light may be highly important. It may mean the difference between getting a picture and getting nothing at all.

For most biological photographic work, the greatest advantage in coated lenses lies in improved quality of negative or projected image. This improvement is most striking in photographs involving particularly wide brightness ranges, such as backlit pictures where the center of interest is in the shadow, and the background is overexposed deliberately to obtain details in the subject. This type of photography has involved so many difficulties that professional photographers shunned such shots before the advent of synchro-flash, whereby the shadowed details could be illuminated artificially to match the brightness of the backlighting.

Where very bright areas are included in the field of view, their multiple reflections inside the lens system appear on the emulsion as ghost images, themselves quite bright but out of focus and diffuse. These destroy the main image in exactly the same way as does a double exposure on a sheet of film. Depending on the relative brightness and the area of bright area involved and its position relative to the axis of the lens system, the ghost may be dim or bright, distinct or diffuse, superimposed or appearing far to one side. Lens designers have studied these ghosts for many years, and modern lenses have been developed with the express purpose of reducing flare patterns to a minimum. Optical engineers have photographed bright light sources against black backgrounds in various ways, to understand better the relationships between lens form, lens aperture, position of the light source and appearance of the

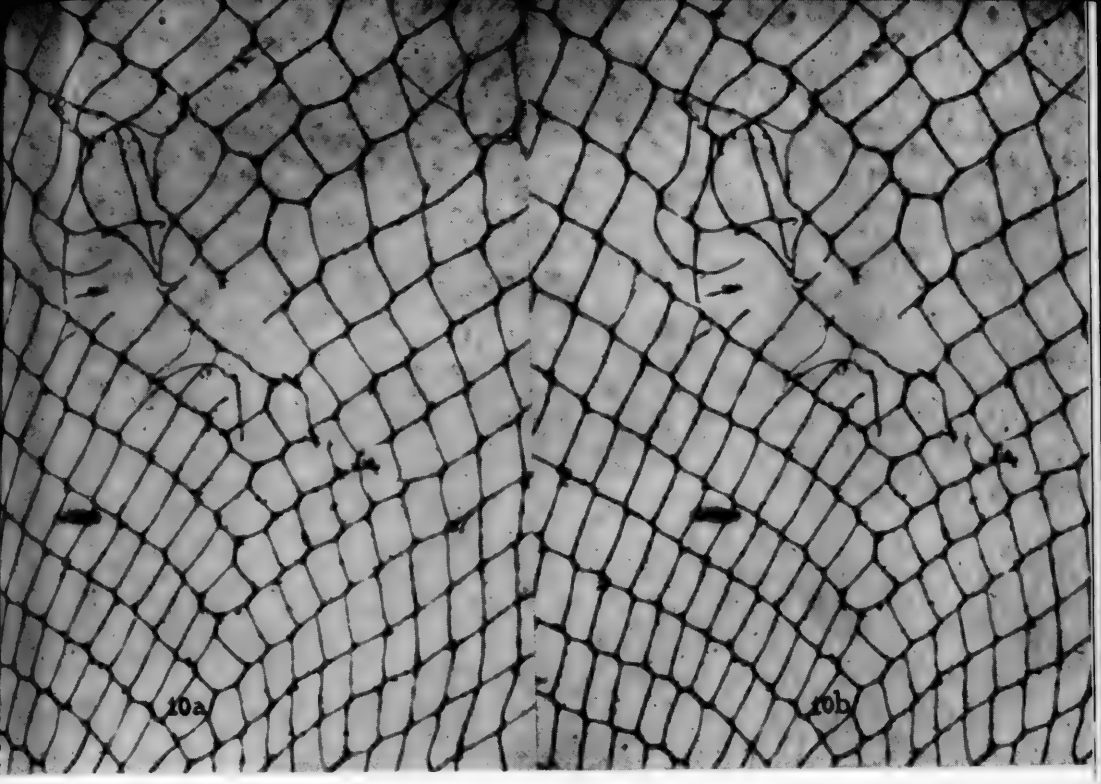


Figure 10. Net of caddis worm Hydropsyche with untreated, a, and coated, b, Micro Tessar 48 mm f.4.5 lenses stopped down to f.9 and with 18 inch bellows extension. Pebbled background is detail of ground glass on the light source, focused in the plane of the net by a divided Abbe substage condenser. Difference in resolution in these photographs is due primarily to less flare light transmitted through the lens elements. The shot with the uncoated lens is less dense than the comparison negative. This difference in effective exposure was taken out in preparing the enlargements for this figure.

ghosts. One of the most successful designs has been the Tessar and Micro Tessar, with a cemented doublet behind the diaphragm and two uncemented lenses in front of it. The four types of glass involved thus presented six glass-air faces which could be coated. This was the type of lens which the writer investigated.

Figures 6 to 9 are a series of comparison photographs taken with the 168 mm Tessars Ic, one plain, one coated, at identical aperture at the same subject and with the same negative material and exposure. The subject was a No. 2 photoflood bulb between a square metal plate having a circular hole, and a remote black background. The plate was black and had some fine lettering in white on its near surface. Figure 6 shows this subject photographed at f.4.5 (wide open) with the lamp on the axis of the lens. The coated lens produced slightly less general fog on the negative, so that the masking plate is more distinct, and the white lettering on it can be read. So also can lettering on the bulb socket. Figure 7 shows the same but with the bulb slightly off the axis of the lens (1 degrees 9 minutes was the actual value). The flare produced by the coated lens can be seen to be slightly off center, but the difference between figures 6 and 7 is not marked. Figures 8 and 9 are more sig-

nificant for the biological photographer since he rarely uses a long focus lens at such large aperture as f.4.5, depth of focus being of more importance in most pictures than is speed of shutter. Figures 8 and 9 were taken at f.32 at corresponding values of exposure. Figure 8 recorded the lamp on the axis of the camera lens, and shows the very remarkable ghosts superimposed as circular flares over the central region of the picture, blotting out all detail there in the untreated lens photograph. The "Balcoted" Tessar held these ghosts to a minimum, so that much of the detail can be seen in the masking plate. In figure 9, the ghosts have separated into two series, one shifted in the same direction as the axis of the lens (the bright spot again 1 degrees 9 minutes off axis), the other series in the opposite direction. Again the coated lens produced an immeasureably better picture. Incidentally copy for these illustrations, and the identical pictures hung in this year's Salon, were projected through the coated 168 mm Tessar, so that the difference between the comparison pairs is entirely in the exposure of the negative. Thus in the untreated lens, the ghosts are more diffuse and less objectionable at large apertures, more distinct and troublesome at small apertures, are superimposed on the main image when the subject is on the axis of the lens, and appear at symmetrically disposed positions with reference to the axis when the subject is off to one side. Coating the lens with low reflectance, high transmission films, such as Balcote, reduces the ghosts to a minimum and greatly improves the definition and contrast in the photograph.

This type of illumination and corresponding difficulty in obtaining good photographs is met in photomicrography of stained sections of plant and animal tissues. The greater area, even with the best critical illumination, is often much brighter than the dark details to be recorded. With an untreated lens the picture may have a characteristically "milky" appearance, as though the whole negative had been fogged slightly in addition to the photographic exposure. With the treated lens, the ghosts of the multiple bright areas in the microscopic section are insignificant, and the details of structure stand out clearly. Figure 10 shows comparison photographs of the water-net which a caddisworm[4] weaves to snare small animals carried into it in swift streams. Both pictures were made on Kodak Super Panchro Press Type B (antihalation) at 18 inches bellows extension from Bausch & Lomb Micro Tessar 48 mm lenses stopped down from f.4.5 to f.9. With identical exposure and processing, that taken through the coated lens shows more detail in the filaments of the net. This was a difficult test for the Micro Tessar, since the water-net was illuminated by a divided Abbe substage condenser focused and diaphragmed for highest resolution, and the lens was so far from the photographic film that reflection from film to lens and back to emulsion

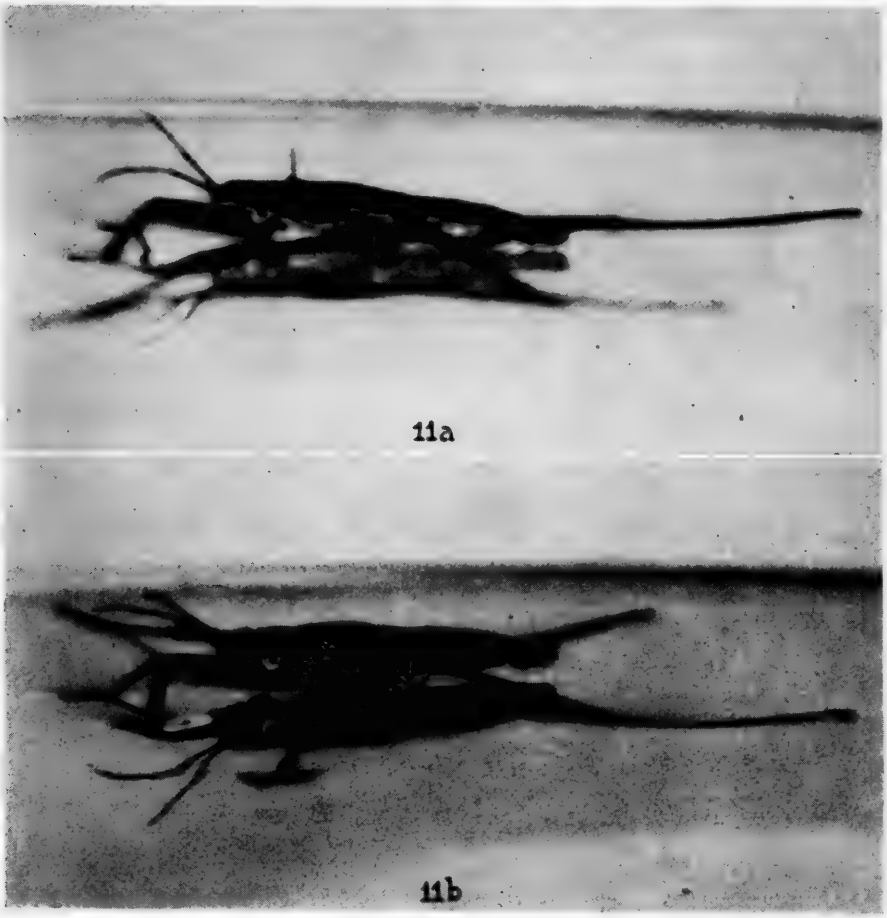
[4] The insect is *Hydropsyche* sp., of Hydrosychidae, Trichoptera.

was minimal. In camera conditions where the film is close to the lens, coated lenses are of much greater advantage and the differences between coated and uncoated optics is far more striking in the pictures taken.

Coated Lenses for Projection and Enlarging

High transmission coatings are very helpful too in lenses for projection purposes. Here uniform illumination is provided on one surface of a negative or a positive transparency, and the variations in transmis-

Figure 11. Water strider on water surface; very low angle photograph to show reflection of insect in water surface. Lenses and film as in figures 6-9, and exposures and iris openings the same in the comparison pair of pictures. The bright background and its reflection fogged the photograph taken with the uncoated lens, a, but the details of the water strider are clear in the comparison shot, b.



sion of different parts of the transparency are imaged by the lens system on the enlarging easel or projection screen. To the lens it makes no difference whether the light received from the transparency has come through the transparency at some particular spot, or is light reflected back to the transparency by untreated lens surfaces. The total light from any one point is what determines the relative brightness of that point. Thus if the enlarging lens or projection lens reflects 15 per cent to 20 per cent of incident light back to the transparency (as do most untreated lenses), the transparency will have that much more light to illuminate the lens. But the light reflected by the lens will not go back to the transparency point for point. Light from a bright area of the transparency will often illuminate a shadow when reflected. Contrast is reduced, fine highlights are lost, and the image on easel or screen lacks crispness and "punch."

The effect of a coated enlarging lens may be added to advantages gained in a coated optical system for the camera. Figure 12 shows one of the long horned grasshoppers, related to the katydid, illuminated obliquely by a single No. 2 photoflood bulb in a reflector 18 inches away. By moving the light source, it was possible to see bright highlights on the fine veins in the green wings. Although the animal posed nicely for the uncoated lens, so that its eye may be seen, the fine highlights do not appear in the picture. In the comparison shot, they are clear, a tribute to the coated taking lens and enlargement through the same optical system. Enlargement through an uncoated lens diffuse the picture and cloud the highlights.

Coated Lenses for Color Work

Coated lenses free the color photographer from the need to restrict his picture taking to flat-lit subjects. Such flat lighting has been considered basic for color work, and variations away from it are sometimes strikingly successful, but more often disastrously devoid of details. Where a photographic subject is almost uniformly bright, its veiling ghosts from untreated lenses (usually operating at large aperture because the film is slow) are almost uniform also, and serve in a color picture to degrade the colors, cloud the highlights and illuminate any shadows so that the picture is "flattened." With flat lighting, only the poor color rendition and loss of highlight sparkle is noticeable in comparison pictures, but in more unevenly illuminated subjects, the black shadows show the coated lens to be giving far truer rendition of values. Thus coated camera lenses for color photography are highly important.

The same is true in projecting color diapositives, whether stills or motion picture film. The use of coated projection lenses for the commercial screen did not come until 1940. Then came a motion picture

Figures 13-14. Pond lilies backlit by a 4:00 P.M. sun reflected by the water surface to show in the corner of the camera ground glass, beyond the picture area used. Lenses and film as in figures 6-9. Note that the coated lens, figure 14, obtained much sharper edges to all highlights and finer detail all over than the uncoated lens, figure 13.

on which extreme care had been taken to prepare the best possible color rendition in the film itself—"Gone with the Wind." All theatres showing this movie were required to use in their projectors the then new Bausch & Lomb Super Cinephor projection lenses, a very fine optical system in which low reflectance coating further improved the projected image's definition, contrast, color values and brilliance. Knowing this, some of us will feel better about the premium prices charged for admission to this picture! Since "Gone with the Wind," coated projection lenses have been regularly called for in good theaters everywhere.

The Future of Coated Lens Photography

The increased transmission of a surface-treated lens system argues for a revised method for marking iris apertures. The light transmission of an untreated lens at f.4.5 and a coated lens at identical aperture are not the same. The latter beam, in addition to relative freedom from flare, contains up to 30 per cent more light, hence requires less exposure by as much as 1/3 stop. Users of coated optics are often in favor of recalibrating the iris markings, so that these are based on percent transmission rather than on the ratio between lens aperture and focal length. length.

Owners of uncoated photographic lenses, seeing the improved rendition characteristic of pictures taken and projected with treated optical systems, are sure to want their equipment brought up to date with low reflectance films. There are a number of difficulties to be overcome in having this done. From the manufacturer's viewpoint there are many risks involved. Unless the old lens to be coated is still in production, even its maker is likely to shun disassembling it, coating it on both sides (two separate operations) and reassembling, all with possibilities of breakage. Replacing a broken lens element with another made specially is prohibitively costly. Duplicating the lens of another manufacturer is even more difficult since the identical glass must be obtained. Furthermore, any stains on a lens, any scratches in its surface, are brought out more prominently by surface coating, and may cause failure of the high transmission film to adhere in some places, so that certain areas of the old lens will have the original reflections (or stained ones), some lack them where the coating has held to the glass. Sometimes complete resurfacing of the lens would be necessary. In addition, unless the firm goes to the trouble and expense to test the untreated lens and retest it after coating, sending the report on these tests with the returning lens, they are liable to accusations of having made no improvements, even to claims that the coated lens is now unable to duplicate feats its proud owner accomplished prior to adding the high transmission film. All of these risks, plus the actual cost of disassembly (often destroying a lens retaining flange in the process, necessitating its replacement), cleaning, special mounting, coating one surface, remounting, coating the second surface, and reassembly (perhaps requiring special swaging machines for mounts which had to be cut and replaced), suggests the preferability in most instances for the photographer to purchase a new, coated lens to replace his old one, if he wishes to share in the advantages of high transmission, low reflection films. Often, too, the cameraman will want to make his own comparisons between uncoated and coated lenses, just as the writer did.

ACKNOWLEDGMENTS

The Bausch & Lomb Optical Company of Rochester, N. Y., furnished the comparison pairs of Tessar Ic 168 mm f.4.5 and Micro Tessar 48 mm f.4.5 lenses, with which the test exposures were made and trial prints enlarged. The company also provided three of the illustrations for this paper. In addition, Dr. A. F. Turner of Bausch & Lomb, who has been very active in the development of "Balcote" has supplied the writer with special information and many helpful suggestions.

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Book Review

THE YEAR'S PHOTOGRAPHY 1945-1946. A Royal Photographic Society Publication. London, England.

It always is a real pleasure to review this Annual. The reproductions, Pictorial, Natural History, and Record, are of the highest type. Each field is represented with pictures showing excellent technic, with good "down to earth" photographic ideas and ideals. They represent the best in good, sound photography.

Geographically, they cover the world from England to Australia, India to North America and the Continent. There are 47 illustrations chosen from the 130 prints hung in the 90th Annual Exhibition at the Royal Photographic Society's House. What a great thrill it must have been to view this salon in its entirety!

This Annual upholds the high standard of achievement set for the whole photographic world by the "Royal," and leaves us waiting for the next year to bring a greater Exhibition and Annual which the advent of Peace will make possible.

Ray Miess.

American Standards Association Notes

Lenses for 2 x 2 Inch Projectors. On July 15, 1945 the American Standards Association published for trial and criticism Z38.1.16 a "Method for Determining Resolving Power of Lenses for Projectors for 35 mm. Slidefilm and 2 x 2 Inch Slides". In this proposed standard is described a test plate containing test patterns with from 10 to 80 lines per millimeter. Test plates may be obtained from the Eastman Kodak Company, Rochester, N.Y. The price is not given.

Your representative has had occasion to test lenses when purchasing light-weight, inexpensive projectors for the use of members of the staff of his institution for use in lecture work outside of the Institute. Lenses for such projectors are inexpensively manufactured, and a great difference has been found in the performance of individual lenses of the same make and focal length. A means of testing these lenses for performance should be of value to the biological photographer who is responsible for the selection of projection equipment. The test plate mentioned above should fill this need. A copy of the proposed standard may be obtained from the American Standards Association, 70 East 45th St., New York 17, N.Y. The price is ten cents.

Films for Permanent Records. The American Standard Specifications for Films for Permanent Records (Z38.3.2.—1945) was published on March 28, 1945. (Price—35 cents). This standard should be of interest to those who produce microfilms or other photographic records for archival use. While this standard is concerned for the most part with specifications of interest to the manufacturer of the film, Section 4 describes the "Processed Film Requirements" which are of interest to the producer, and Section 5 describes the different tests to be used in determining whether the processed film meets the specifications. Of particular interest is the test method for determining the residual thiosulphate (hypo remaining in the film after processing). This test method was described in detail by Crabtree and Ross in the Journal of the Society of Motion Picture Engineers, 14:419 (1930). The description in the standards is sufficient for use in the laboratory, and the test is easily made.

LOUIS PAUL FLORY
Yonkers, N.Y.
BPA Representative

Film Slides and Movie Titles

William F. Payne*

FILM slides and titles for motion pictures are not new to the biological photographer but many photographers avoid doing this type of work and when asked why, the answer seems to be, "I am the worst hand-letterer in the world." There are a number of photographers who are quite capable of doing excellent hand-lettering but for the many others, like myself, whose ability is practically nil, I present this article.

One type of photography that is little used and yet has great possibilities is the film slide. Literally, they are lantern slides made on a strip of 35 mm positive film. Perhaps the first to recognize their value was industry, especially the automobile manufacturers. Some of these manufacturers, during the period when models were changed, made a series of still photographs 5 x 7 or 8 x 10 in size, showing how the new carburetor or some other part in the car or motor was assembled. These photographs were mounted on card board with appropriate titles. Negatives were than made on 35 mm films. Hundreds of positive copies were made from these negatives and sent to the different dealers throughout the country to be used to teach the men who would service the new cars. The film slides were so edited that they were self-explanatory. In this manner the quickest and easiest way to repair a certain part of the new car, together with the necessary tools and how to use them, was demonstrated. There is no doubt that the visual picture of such an operation was much better than reading a lengthy explanation. Leaders in industry were quick to appreciate the value of film slides. Salesmen, given a small 35 mm projector with a properly edited film slide, were in a position to give a very comprehensive demonstration of the particular product they were selling.

Sometime ago a salesman who was selling electric refrigerators called at my home. He asked if I was interested and upon inviting him in, he proceeded to give the family a very clever demonstration of his product. From his pocket he took a 35 mm film projector, about 6 inches square and about 1½ inches thick. Using the wall for a screen, the salesman proceeded to give a splendid sales talk for about thirty minutes. He went into the principle of electric refrigeration so that even the children understood what he was talking about. After the demonstration I asked him what he had been doing before he be-

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* From the New York State Institute for the Study of Malignant Diseases, Buffalo, New York. William H. Wehr, M.D., Acting Director.

came a salesman. His answer was that he had been a farmer with a grade school education in a rural school. This proved that with this medium an inexperienced salesman was able to talk intelligently on a subject that was quite technical.

Authorities in public health were likewise quick to realize the value of film slides. Here was a visual medium of demonstrating the facts of certain public health problems. As a result, films that tell the truth about cancer, syphilis, tuberculosis, and other preventable diseases are being shown before lay audiences. Teachers and lecturers have used film slides in presenting their subject material, step by step, in a very orderly and complete manner. If a review of the lecture is necessary at a later period the film slide can be shown again; all the preparation necessary is to explain new references and advances on the subject. This visual method has thus proved to be a valuable medium in teaching any subject.

Motion picture titles are of equal importance. Many of us thought that when sound movies were used, titles would be a thing of the past but this was not true. However, sound films are expensive, they do require special cameras and even with a camera equipped with sound speed, in which the sound is dubbed in later, the application of sound to the film is expensive. Aside from a commercial film, few films with sound are available in schools, research institutions or hospitals. Thus there remains only one medium for explaining motion picture—titles. It is true there are splendid titling services throughout the country. Perhaps their greatest drawback is the time aspect in sending titles to be made and waiting for them to be returned. The charge made for these titles is reasonable, but it has been proven that it is still more economical to make your own. This is especially true when the photographic department must operate on a budget. Positive film is cheap and by adding a titling service, a valuable addition has been made to your department and again the importance of the photographic department in an institution has increased.

TITLES

In order to be effective, titles must be clearly made. The lettering must be as perfect as possible. The wording must be carefully selected so as to make it possible for all viewing the film to understand the message clearly. If the film is strictly for a scientific audience it must have scientific language. If the film is to be shown before lay audiences, simpler terms must be used. However, caution must be exercised not to make it too elementary. In using film slides or titles, select the wording carefully. Understand the idea of what is to be explained. Discuss it with others you know are interested and when a decision

has been reached, make the titles brief and to the point. It is possible in a motion picture to "over title." So it is well to remember that an audience wants to see action and pictures, not read a book.

LETTERING

Good lettering adds considerably to the success of a film. As mentioned before, lettering is the chief cause for avoiding the making of titles. There are many types of lettering systems available. Each has its virtures but one which seems easier and cheaper than the others will be described. It is the Leroy lettering system manufactured by Keuffel and Esser Company. Its simplicity to operate gives it a distinct advantage over the others. With this system one template will produce vertical and slanted letters or figures when using the adjustable scriber. It is also possible with the same template to make capitals and lower case letters. The adjustable scriber and the template that includes capitals, lower case letters and numbers is recommended. This one lettering template costs less than four which would be required when using other types of lettering devices.

The template controls the height and width of the letter. There are seventeen different sizes ranging in height from 8/10 inch to two inches. However, only thirteen templates permit slanted letters. These include all sizes from 8/10 inch to ½ inch. At the base of the template there is a measuring device whereby one is able to measure off the distance from the center of a title to the both ends so that the lettering in that particular line will be centered on the title. This is of utmost value when you want a certain number of letters to fit in a given space. The width of the lines which form the letters are controlled by a pen which fits in the scriber. These range from 00 to No. 14 and give a range of about 1/32 inch to 1/4 inch in width. The pens consist of an ink well, which holds a considerable amount of ink, depending on the size of the pen and a cleaning pin which controls the flow of ink. All inks, especially when using the 00 and the 0 size pens, seem to clogg the small opening from which the ink flows. This can be avoided by lifting the scriber free from the title and raising the cleaning pin sufficiently until a bubble appears on the end of the pen. Drop the cleaning pin down in place, remove the bubble with a blotter or the tip of the finger, and the pen will continue to write. The chief reason for this clogging of the pen is that it was not properly cleaned after it was previously used or when not used for a period of two minutes or more. For filling the ink well of the pen an ordinary eye dropper is recommended.

There are really three different types of scribers available. Number 1 is a fixed scriber. Number 2, the adjustable one with which you

can make both vertical and slanted letters and figures. Number 3 is a fixed scriber and is used only for the larger numbers and figures. The larger letters and figures range from about 3/4 inch to 2 inches in height.

Figure 1 shows the entire set-up used for lettering. Aside from the Leroy lettering outfit the following items will prove helpful: drawing board, T square, C clamp, and a small pair of mechanical drawing dividers. Other items that will be of assistance are a large pair of dividers, 45 and 60 degree angles. A good quality of drawing paper is held in place on the drawing board with thumb tacks. Select the size of the lettering templates that will produce a title in the space of the paper, keeping in mind that the size of letters when photographed will not be too small, and will be legible when projected on a small screen. In figure 1, A is the lettering template. It is held in place at the proper level by the T square, I. This eliminates the worry of not producing parallel lines. The template (A) slides back and forth to form the letters for the words in the title, and is always parallel. The T square is held in place by a small C clamp, J. This has been found to be very helpful. With the aid of pencil marks the spacing from one line to another is accomplished. In order to demonstrate these pencil marks, ink dots are shown at D. The dividers shown at E space off evenly the number of lines necessary to complete the title. By using these dividers one is assured of evenly spaced lines throughout the title. C is a common eye dropper used to fill the pen with the kind of ink suitable for the title. B is the script from which the wording for the title is taken. It is suggested that all titles be typewritten as it aids considerably in judging the number of words that will fit in each line, and will prevent the remaking of many titles. With the larger pair of dividers one can space off from the script just how many words will fit in each line. This has proven to be a great time saver. It will also be found that by sliding the script under the drawing paper as shown at B you will not omit or go ahead of the words in their proper sequence. As a line is completed on the script, the script is pulled up to the next line. F, G, and H are parts of the adjustable scriber. F is the ink well which holds the ink.

In lettering, if the type of paper used absorbs the ink unevenly, each letter can be traced several times without blotting the letter. With the smaller letters, that is those about 1/8 inch high, it will be necessary to do this. When using letters 1/2 inch and larger and also using a No. 6 or larger pen, care must be exercised when moving the scriber from the completed letter to the next one. The bubble of ink which forms at the end of the pen should be removed with a small blotter. Speeding up on the lettering will eliminate this bubble. H

is a blunt pin located under the scriber. This pin rests in the longitudinal recess as illustrated and acts as a pivot to the arc necessary to form the letter. Practice will teach one to automatically keep the pin in this recess. What causes the letter to be formed is at G. It is a

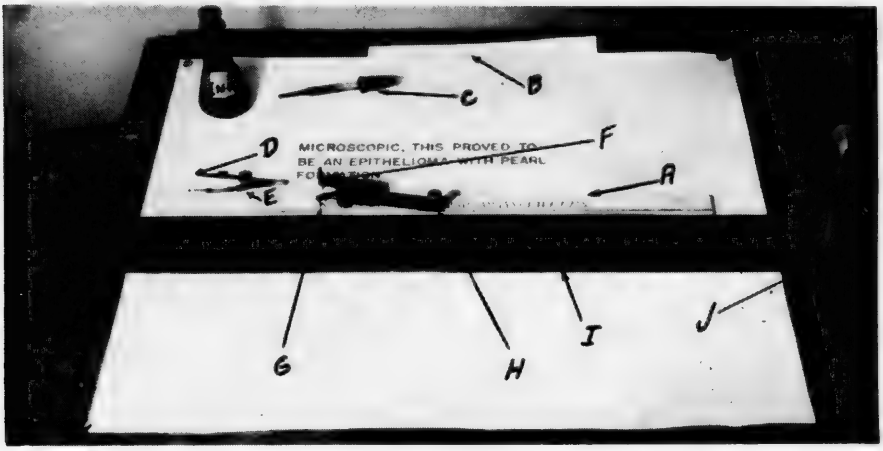


Figure 1

semi-sharp pin that fits into the recess on the template. This recess is about 1/32 inch deep and when this pin is placed into the recess all that is necessary is to follow the formation of this letter on the template and the pen (F) will make the letter on the title. For the beginner who has never used the Leroy template a little practice is advisable. The template will produce even, well formed letters which can be duplicated each time. About the only thing the template will not do is to spell correctly. The spacing necessary between each word is best judged with the eye and one soon accustoms himself to this. Figure 2 is a good example of either a movie title or a title that can be used for a film slide.

Lettering Material

The type of cardboard used for titles is important. It is apparent that cardboard is an important war product and one which the government has asked us to conserve. To waste it is not economical nor is it patriotic. Therefore, it is suggested that a good grade of board be used which will allow scraping the surface in case of error and still permit relettering over the scraped surface without blurring. This is possible only with a good grade of white cardboard since scraping is not possible on cardboards colored on the surface. Both Bristol and Illustration Super Royal 6 ply board have proven excellent for this purpose. This thickness will not wrinkle and will lie flat in the frame or support.

The following colored boards have proven satisfactory: Falpaco Railroad board, Buff, Lemon, Yellow, Red, Blue, Violet, Pink, Salmon, and Black. With the exception of the black, all have a slight sheen to the surface, very much like a semi-matte surface photographic printing paper. This sheen is not objectionable providing the light illuminating the titles is properly used. The black is an excellent board and has an absolute matte surface.

Remember that the background will affect the lettering. Some time ago a commercial firm had an exhibit of a series of four color prints. All four were of a large single pansy. The only difference in the four prints were the mounts. One mount was black, one was green, the third blue and the fourth a white mount. To the eye one was almost convinced that they were four different pansies, or the color prints of different densities. Yet when the mounts were blocked off the four prints were the same. This fact is mentioned to show that a background will greatly affect the lettering.

In color portraiture, the alert photographer will place the colored background a little to the rear of the subject. When this is not done, reflected light from the background will be reflected on the subject. Hence it should be kept in mind that the lettering on the cardboard is in close proximity with the background.

The lettering ink should be selected with care. Principally inks fall into three classes, black, white and colored. Most generally black is used. The black ink must photograph black and not gray. The best ink we have found to do this consistently is Higgins Waterproof Drawing Ink, commonly called India ink. Never dilute it with water. If there is insufficient ink to finish a job do not begin. Be sure that the pen is dry when you start. This will make the first letter as dense as the last. It cannot be emphasized too strongly the importance of even densities in lettering. The photographic lens and the film will show any unevenness very distinctly, and when projected on a screen of any size, will be more than noticeable.

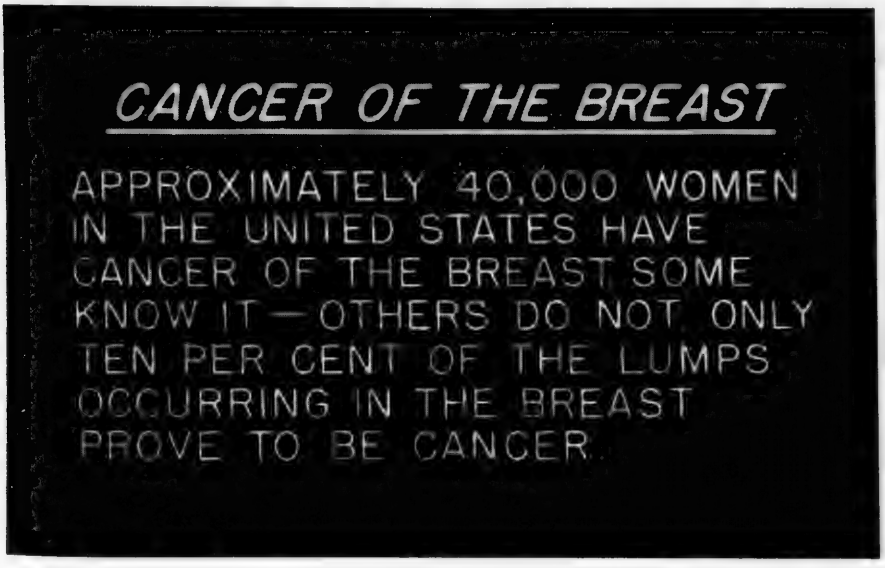
In making titles most persons prefer white letters on a black background. Therefore it is not necessary to make a negative in the sense of making a positive from this negative if the title is made on a white board with black letters. The copy made from the title will be the copy used. When making a title in this manner the resulting copy will be white letters on a black background. If a duplicate title for a second film is wanted it is suggested it be made in the same manner. This is most convenient and economical.

When making film slides the technic is reversed in most cases. A negative must be made because duplicates are necessary and the negatives are much shorter in length than a movie title. When making

the titles use a black cardboard with white letters so that the finished positive will be the same. White ink has been a problem. It will not stay in solution as well as the other inks. It requires constant agitation and if this is not followed the white suddenly becomes gray. Many use Chinese white water color mixed with water which produces a good white. However, it has been our experience that each time you mix this white ink, unless considerable caution is used, the white of the first batch is not the same as the white of the second batch. If the white ink is being used every day perhaps this Chinese white would answer the problem. As titles do not constitute a daily routine, a white ink is required that can be used when necessary without too much delay in preparing it. For this reason alone Sanford's White Ink is suggested. This is a good white ink, and if constantly shaken to keep it in solution, the results will be satisfactory. In each 1¾ ounce bottle of this white ink there is a piece of plate glass about ¼ inch thick with very sharp edges. This will aid you in shaking the white ink into solution. After shaking for a short time one can hear this glass rattle inside the bottle. Thus, when the glass is free from the sediment it is a good indication that the ink is ready for use. However, it is suggested that it be shaken for a minute longer

Since white ink is a little more difficult to use than the black ink a little explanation might help. When a letter is made, it will be noticed that the Falpaco Railroad Cardboard will immediately absorb the white ink, with the result that the letter will appear gray. This

Figure 2


CANCER OF THE BREAST
APPROXIMATELY 40,000 WOMEN
IN THE UNITED STATES HAVE
CANCER OF THE BREAST SOME
KNOW IT — OTHERS DO NOT ONLY
TEN PER CENT OF THE LUMPS
OCCURRING IN THE BREAST
PROVE TO BE CANCER

will gradually whiten as the ink drys. However, if it does not whiten sufficiently to be satisfactory, retrace the letter three or four times until you have a good deposit of white ink on the cardboard. The Leroy pen will not blot. Care must be exercised to avoid touching the newly formed letters for this heavy deposit of white ink will take a considerable time to dry. Even when dry, if the title is not handled carefully you may chip off parts of the lettering.

The third type of inks consist of the colors. Kodachrome films demand colored titles. Again, all inks are not suitable for titles. The colored letters must be of greater importance than the background. By this is meant that the effect of the lettering on any one viewing the film would be that the eyes would notice first the color of the lettering rather than the color of the background. As to what color is best? This no doubt, is a personal choice. Some will like pastel shades, others will like contrasting colors.

The color inks which have given very satisfactory results are Higgins Waterproof Drawing Inks. The following are the principle colors used: Blue, Blue Violet, Green, Red, Yellow, and Brown. These will give a solid color, and with the proper use of the Leroy Lettering Scriber, the lettering will be very even.

White letters will blend very well on a light red background or on a light blue background. Black ink will take well with yellow and green cardboard. Other good combinations are as follows:

Ink	*Backgrounds*
Blue	Red
Green	Dark green and lavender
Maroon	Green, Blue
Lavender	Pastel green

CAMERAS

For motion picture titles any camera is satisfactory. The only problem will be the focusing. With cameras that have a reflex focusing attachment, the answer is simple. For other cameras it will be a case of trial and error until you have found the proper point so that titles are not distorted and the focus is sharp. There are suitable copying stands on the commercial market that can be used. It is not too difficult to make a satisfactory copying stand which will afford many advantages. Set the easel, which holds the title, in its proper place. It is suggested that a printing frame be used with the glass removed. If the titles are cut correctly they will fit snugly. The purpose of removing the glass is to eliminate reflections. The printing frame will hold the title flat at all times. Cut the cardboard on which the title is to be lettered, a little larger than the printing frame. In trimming

the finished title be sure the bottom cut is absolutely parallel to the lines of the lettering. This can be accomplished by using a trimming guide on the trimmer. The other three sides of the cardboard can then be cut to fit the printing frame. However, before cutting these three remaining sides, mark off on the other border of the title, the exact center, horizontally as well as vertically, which will assure centering the title. When placing the finished title in the printing frame, care should be taken that it is squarely placed in the frame. This will assure parallel lines. To correct for distortion, place a piece of white card board in the printing frame and mark off the exact center both horizontally and vertically. The point where these two lines cross, will determine the level at which the camera lens must be placed. If the camera is perfectly centered there will be no distortion in the resulting titles.

Focusing should be a comparatively simple problem. Set the focusing scale at four feet or the closest focal point on the camera. Make an exposure on positive film of about one foot. Develop this strip and judge from the developed film the accuracy of your focusing as well as the size of the field that the distance from the camera to the title will cover. If it is not sharp, it is a question of adjusting the camera forward or backward. When this point is found, mark it clearly and accurately so you will know where a sharp focus is obtained. If you can not get coverage of the title due to the distance necessary for your camera to be placed in relation to the title, then increase the size of the card board and use a different size letter. One or two exposures will settle this problem. Exposure, 16 frames per second (silent speed) using the diaphragm to control the desired density.

To make film slides a 35 mm single frame camera is necessary. Here you may find some difficulty in obtaining a camera. Not because of the war but because the few cameras that were made have been discontinued. However, there are some used cameras still available. Ansco manufactured a Universal Still-film copying camera, which was really a double camera with a single lens. One camera afforded ground glass focusing and when critical focus was obtained a shift was made to the second camera containing the film over the camera lens. After adjusting the diaphragm, the exposure was made. One wonders why this camera was discontinued as it afforded copying anything from 1⅝ x 2½ inch to 11 x 14 inch. Another type of camera is a hand operated 35 mm motion picture camera. The camera which the author has found very efficient is a Sept. There are two types, single spring and double spring. Of the two, the double spring is the better one. The Sept cameras are still available through Burke and James of Chicago. This Sept camera has three exposures, one instantaneous with

a speed of about 1/30 of a second; the motion picture speed of 16 frames per second and a time exposure that works on the same principles of a bulb, that is as long as you keep the shutter release depressed the shutter will remain open. One good feature of this camera is that by unscrewing the disk on the back of the camera and with a strip of Traceolene inserted where the film is located, one can view the size of the field the lens is covering and what is more important, provides excellent focusing. If all titles are properly centered and the title holder is at the same distance, all resulting pictures will be sharp. The camera lens is equipped with a diaghragm which aids in resolution. The lens is an f. 3.5. The film for the camera is enclosed in a film magazine and extra magazines cost about $1.50. One loading will accommodate about 17 feet of film. This film both positive and negative can be purchased in 50 and 100 feet spools.

LIGHTS

Even illumination is very essential. At one time the author used two 15 watt 18 inch fluorescent tubes in a good reflector. This is a good light, is cool and provides a very even light. We had two parabolic reflectors made and the inside surface was painted white. The lights which are now being used in the same reflectors are four No. 1 photo floods which give a much more intense light which obviously aids in shortening the exposure. Due to the fact that this equipment is used for other work than film slides and titles, it was necessary to change to the photo floods rather than the fluorescent tubes.

A good example of this change was when both 35 mm and professional Kodachrome films were used. As you well know, photo floods are necessary for the 35 mm size and the professional Kodachrome requires a light that produces a color temperature of 3200°K. In illuminating titles, care should be exercised as to the position of the lights in relation to the title. If the sheen on the card board, mentioned above, is noticeable on the finished film it can be eliminated by careful manipulation of the lights.

The lights and camera stand used at the State Institute was made by the carpenter at very little expense. As mentioned before, there are other uses to which this stand has been adapted. Figure 3 is a side view of the entire ensemble. The table is seven feet long and is 30 inches high. Atop the table at A is a bed which allows the camera support to slide backward and forward to obtain sharp focus on any size copy. On the left at B is the easel which supports the titles. This easel consists of a horizontal support which permits a printing frame to be inserted. Note three other size holders at C. C^1 is the 8 x 10 with an 8 x 10 printing frame beside it. C^2 is the 5 x 7 holder and C^3

is the 14 x 17 printing frame placed in the 14 x 17 holder. The outside dimension of these holders is 20 inches square and they can be used both horizontally and vertically and are also interchangeable. The outline of the channels which hold the printing frame to the holders in C^1 and C^2 are outlined in white lines to give their respective position

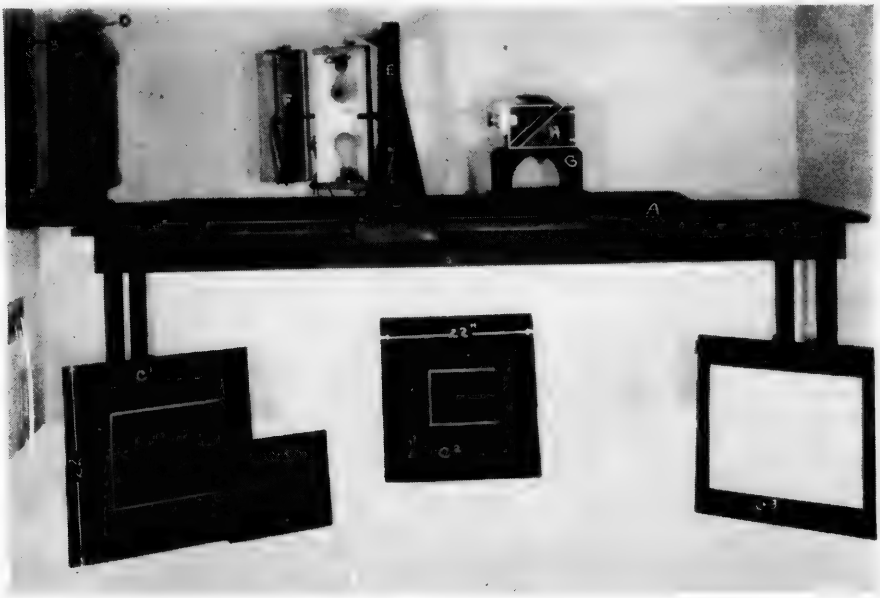


Figure 3

as to the holders. The printing frame holders are held in place by a C clamp at D. The light support can likewise be pushed forward and backward to give the proper lighting to illuminate the titles. F are the two parabolic reflectors. A front view as well as a side view can be seen in figure 3. These two reflectors are attached to the light support E. They have two jointed supporting arms illustrated in figure 4 and they can be shifted 180 degrees. G is the camera support which as stated above can be pushed forward and backward to focus and cover the size title used. In figure 4 at J and K are two holes. J is for the tripod screw that attaches the movie camera H to this support. The other hole K is for the tripod screw that attaches the Sept camera for making film slides. These holes are of different diameters because the tripod screws are of different diameters.

PRINTERS

To make duplicates of movie titles, a continuous printer is necessary. As stated before, this not recommended. However when condi-

tions exist that make this necessary the answer is the continuous printer. There are two very good printers of this type commonly used. There are others but because the author has used both printers, and again because the nominal cost of the printers places them within reach of the budget of the average photographic department, they are recommended. The Stineman printer is a motor driven printer and can be obtained in both 16 mm and 35 mm sizes, and is simple to operate. The Arri printer is likewise a motor driven printer, also made in both 16 mm and 35 mm sizes.

For film slide positives a continuous printer is best, especially if a number of duplicates are to be made. The actual printing takes but a few seconds. The negative and positive films are placed emulsion to emulsion into the printer, the light is turned on so that it is exposed to the negative film first. The printer is put in motion and after the exposure is made the positive film is ready for processing. For those who prefer a step printer there are a number to choose from. A step printer is one in which each negative is exposed separately or by steps, on to the positive film and requires considerably more time. The Ansco Memo positive film printer model B is used in many laboratories. Ansco also make a positive film top for a 5 x 7 printer, which sets on top of a regular printer. At The State Institute a step printer is used which is also made by Ansco. It is their Duo-Reflex printer. This printer has two printing reels. Its greatest value is that with this printer you can change the sequence of a film slide very easily without remaking an entire new negative. If for example you want to add to a film slide, frames from another negative or negatives this is easily accomplished. Another advantage of the Duo-Reflex printer is that it is possible to visualize the picture before making a positive without fogging the unexposed positive film. The Oliver is another type of step printer.

Films and Developers

For movie titles Eastman positive film has proven very satisfactory to the author. It has a semi-fast emulsion and when developed in D-11 the results are excellent. A few suggestions that may help are: that if the negative is flat develop for seven minutes; if the negative is normal in density develop for three minutes and if the negative is contrasty develop for one and one half minutes. This positive film comes in both 16 mm and 35 mm sizes.

When making film slide negatives it will be difficult to find a better film than Eastman 35 mm Pantomic X film. This film is a panchromatic emulsion and when color is in the original copy and especially when the color is red, good copies will result. Wratten filters can be used to great advantage also. Another reason for this choice of film,

is that it is a fine grain film with a resolving power of 50. This denotes the number of lines per mm which can be shown as separated in a negative on a particular film. It is strongly suggested that D-76 be used for processing Panatomic X film. This developer is much better than any so-called fine grain developer for this particular film. It has been proven that you will find a loss in negative speed if any other developer is used. D-76 and D-11 are available in prepared form and for those who wish to mix their own developer the formulas can be obtained from the manufacturer.

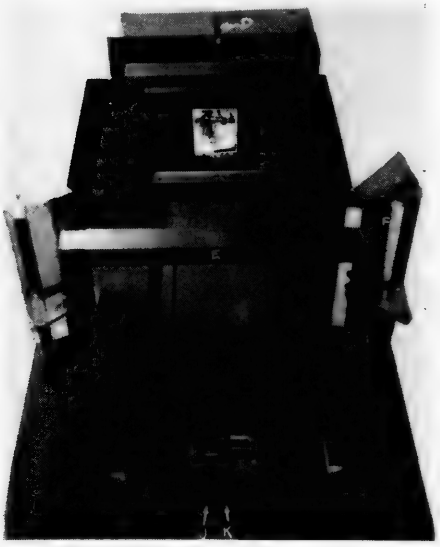


Figure 4

SUMMARY

Film slides and movie titles are not difficult to make. They are of utmost value to an institution and by adding this service to a department the value of the department to the staff as well as institution has again increased. It is another job added to the department but it is another reason for having a photographic department. Lettering titles is a simple procedure. Titles can be produced with the Leroy lettering templates as good as the best. It is easy to operate, and the longer it is used the easier it becomes to operate. For those who do not make film slides, I feel sure that when a staff realizes they can be made within the institution, the film slide will be in demand. In a teaching institution they are greatly appreciated and will serve the teaching staff in cutting down hours of preparation of the lectures they give. Until used, their value will not be appreciated. They can be mailed without fear of breakage. Four cents in postage will send ninety exposures, including the metal mailing tube, half way around the world.

Convention Visits Pavelle Laboratory

Anne Shiras

Members who toured the Pavelle Color Laboratories at 533 West 57th St., New York, September 15, 1945 felt that at last they were seeing some of the post-war advances they have been hearing so much about. In this roomy air-conditioned building, miniature color transparencies are enlarged to 3 x 4½ inch color-prints at the rate of one a second by electronically-controlled printers.

Human judgment enters into the first step only; a certain amount of color-correction can be introduced by changing the color-temperature of the light. The operator, working under white light conditions throughout, sets the printer for proper color temperature and the number of prints required. From then on every operation through which the prints pass is completely automatic. The prints are made on 5 inch rolls of Ansco Printon 5 inches wide. One or more prints, up to fifteen, can be made from a transparency by turning a selector control to the number of prints desired. If more than fifteen prints are required from a transparency the machine can be set for continuous operation until the required number has been made. A counter indicates the number of prints as they are made. The exposures are controlled electronically by directing the light passing through the transparency to the phototube by means of a prism and lens system. The customer's order number is automatically recorded on the roll of Printon along the edge. The exposed rolls of Printon are developed in a continuous processing machine, which is certainly one of the largest machines of its kind ever built. It is 125 feet long and when filled to capacity holds a total of nearly one-half mile of pictures. The solutions are controlled to very close tolerances by circulating them through regulated heat exchangers.

Lloyd Varden, Technical Director of the Laboratory, conducted the trip, and the members were obviously greatly interested. As the plant was not officially in operation at that time, every process was demonstrated while test-rolls of Printon were run through the processing machines. Orders are now being taken for a seven-day color printing service furnishing 3 x 4½ inch prints from 35 mm and Bantam transparencies at $1 a print. Later a complete range of print sizes from all sizes of transparencies will be available. The plant's normal operating capacity is between 30,000 and 40,000 prints a day.

Early Photomicrography

M/Sgt. Howard B. Lawson *

IN a recent issue of *The Journal of The Biological Photographic Association*[1] it was stated that the earliest photographs of eggs, and so far as the author knew of any biological material taken through a microscope, was in 1887.

An investigation of the photographic files at the Army Medical Museum, Washington, D. C. reveals that Colonel J. J. Woodward had

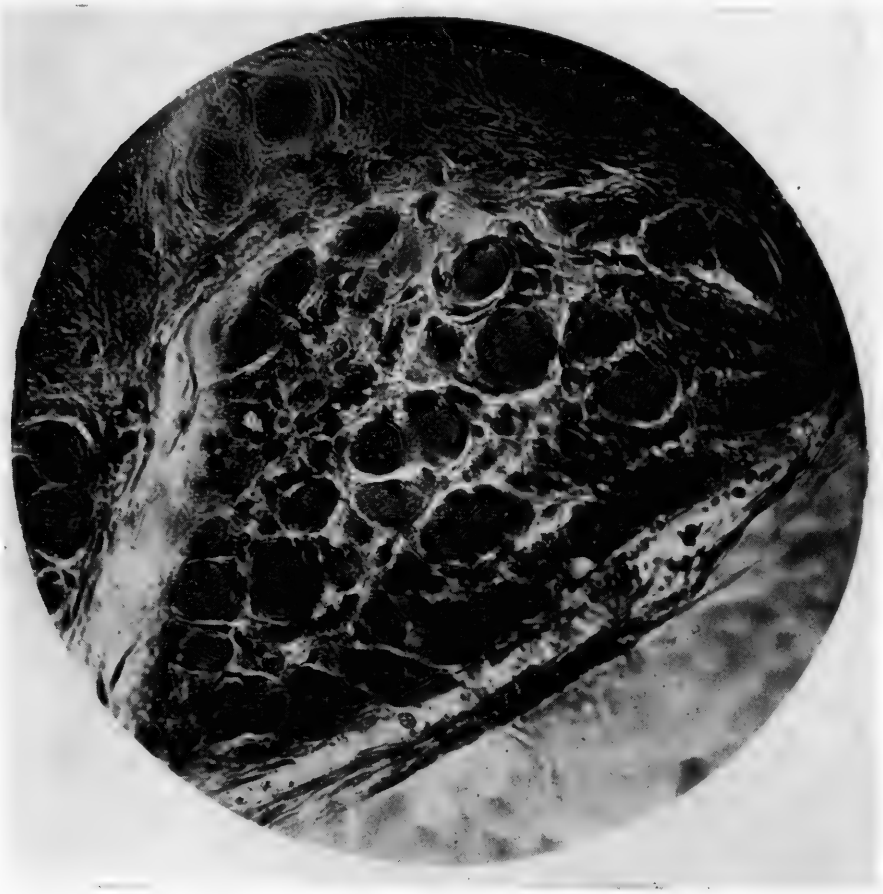


Figure 1. Lip, Epithelial Cancer. February 4, 1873.
(Photo by Army Medical Museum)

* Received for publication September 14, 1945. From the Army Institute of Pathology, Army Medical Museum, Washington, D. C.

[1]Harvey, Ethel Browne: Early Biological Photomicrographs. J. Biol. Phot. Assn. 13:177, June, 1945.

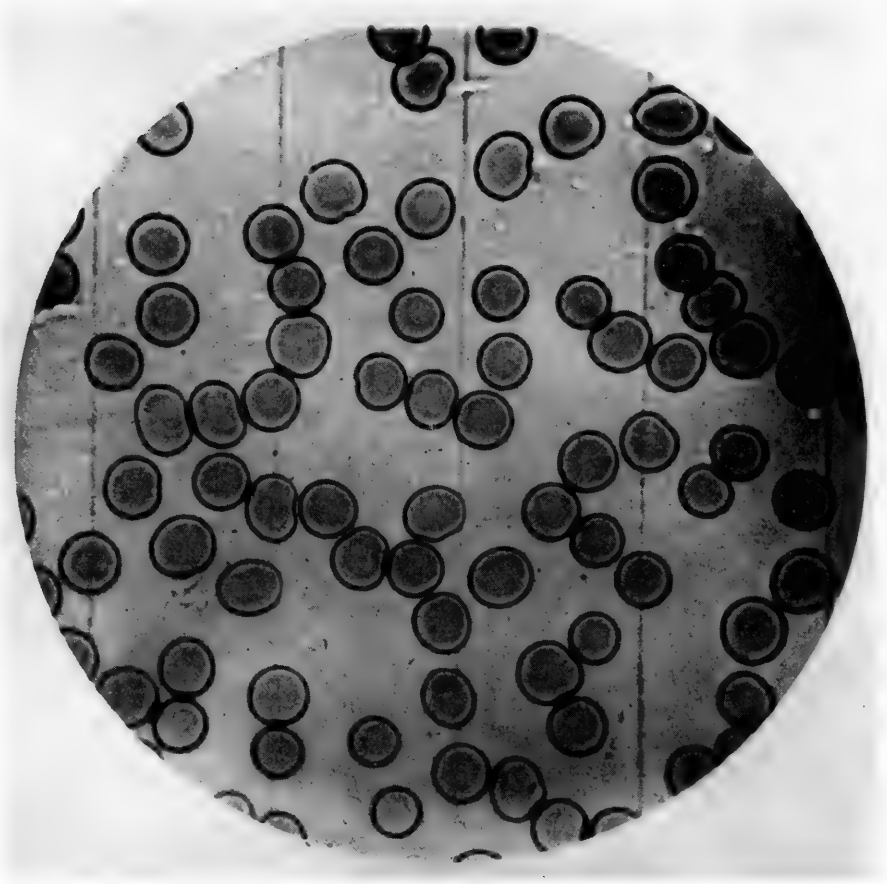
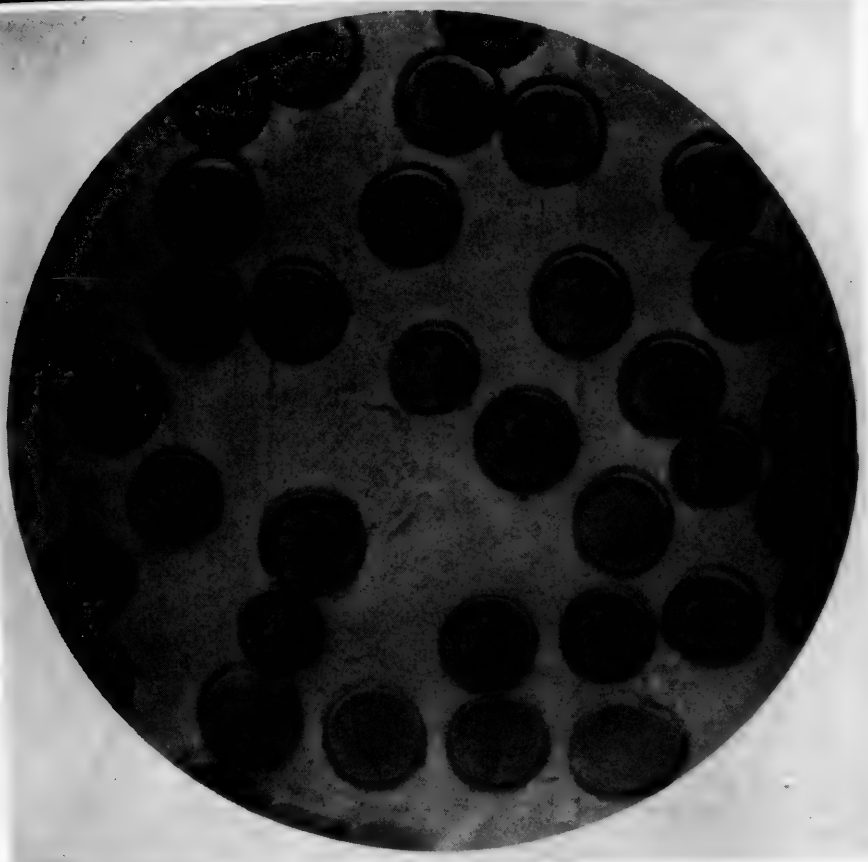


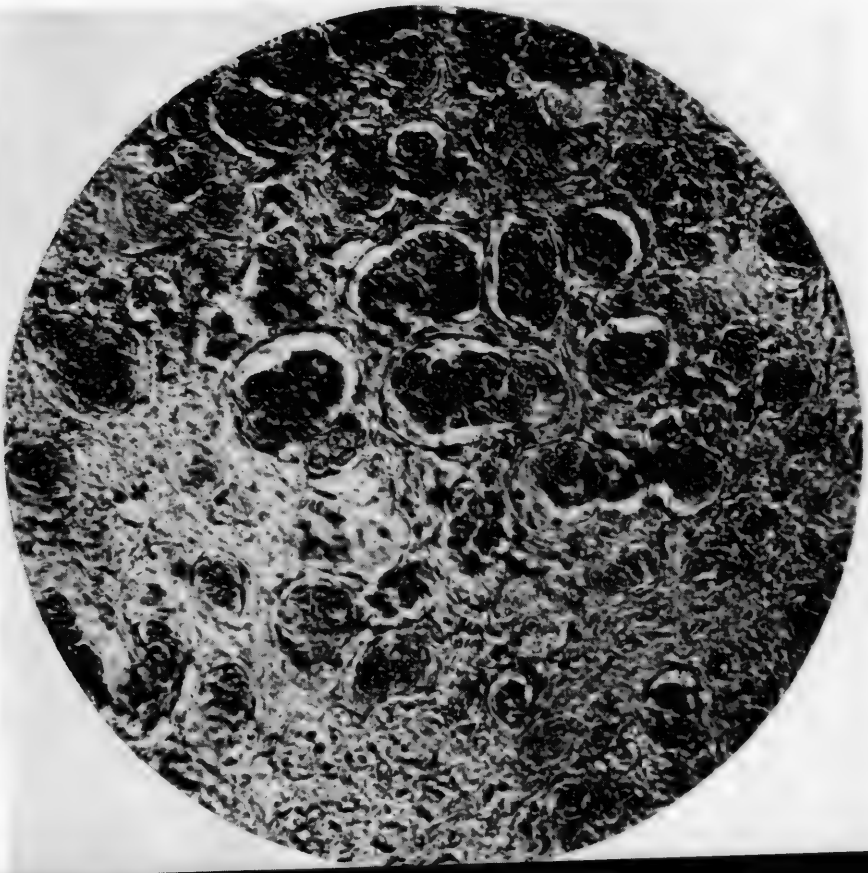
Figure 2. Blood, Human. X1275. May 21, 1877.
(Photo by Army Medical Museum)

taken hundreds of biological photomicrographs prior to 1887. His work on wet plates goes back before 1866, more than twenty-one years previous to the aforementioned date. In 1866 Colonel Woodward published an article entitled, "On Photo-Micrography with the highest powers, as practised in the Army Medical Museum".[2] In this article he describes in detail the methods used and the difficulties which had to be overcome. It is interesting to note that Colonel Woodward's negatives (glass) are virtually without grain. Figures 1 through 4 are typical of Colonel Woodward's workmanship. These are contact

[2]Woodward, J. J.: On Photo-Micrography with the highest powers, as practised in the Army Medical Museum. Amer. J. of Science and Arts. 2,s. 42:25, Sept. 1866.

Figure 3. Top, page 93. Blood, Human. X2200. May 21, 1877.
Figure 4. Bottom, page 93. Liver, Cancer. X450. January 29, 1872.
(Photos by Army Medical Museum)





prints from the original negatives. His apparatus was essentially a heliostat throwing the sun's rays into a darkened room through a microscope and on the light-sensitive material, usually the wet collodion process. Figure 5 is an illustration of the equipment used.

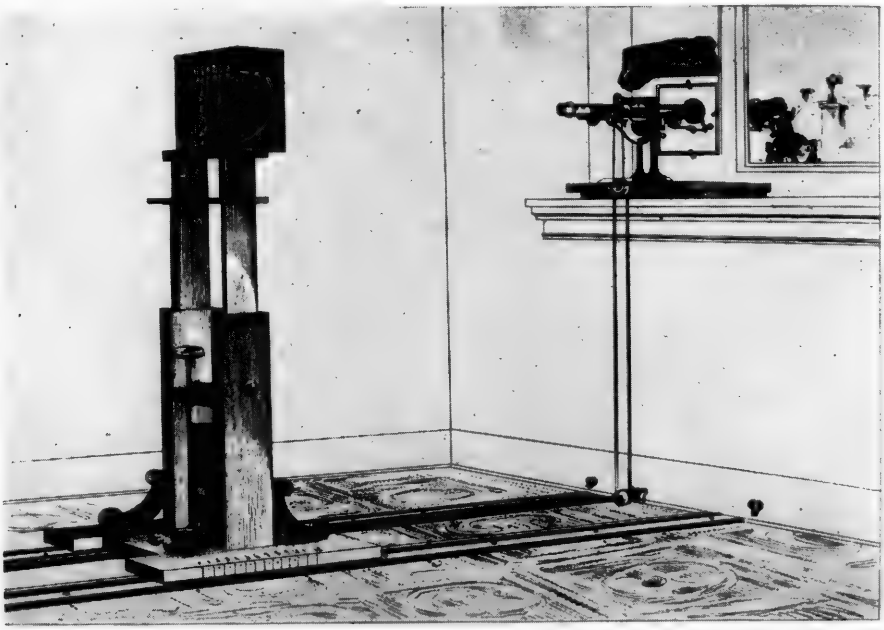


Figure 5. Apparatus for Photomicrography. (Photo by Army Medical Museum)

In 1883 a very excellent book entitled *Photo-Micrographs and How to Make Them*[3] was published by George M. Sternberg. It is illustrated with forty-seven photomicrographs reproduced by the Heliotype Process. Much of the text of this book could very easily be taken to heart by present day conscientious photomicroscopists. In 1881 Dr. Sternberg photographed the tubercle bacillus.

To anyone especially interested in the history of photomicrography, *The British Journal Photographic Almanac and Photographer's Daily Companion of 1903*[4] gives quite a complete background. The bibliography to the article indicates considerable activity in photomicrography of biological subjects between 1853 and 1882.

We must not forget in reviewing old photomicrographs that histologic technic has improved immensely. The early workers were handicapped by poorly prepared sections and it is truly amazing that they could produce standards of work which even today are still a challenge to photomicroscopists.

[3]Sternberg, George M.: Photo-Micrographs and How to Make Them. Boston, 1883.
[4]The British Journal Photographic Almanac and Photographers Daily Companion of 1903. 691.

Half a Century of Roentgen Rays

Otto Glasser, Ph.D.*

Toward the end of the last century many physicists felt that there was little more to be discovered in physical science. A notable exception was a group of cathode ray workers, including such well known scientists as Hittorf, Crookes, Hertz, Lenard and Röntgen.

In 1895 W. C. Röntgen was professor of physics and rector of the University of Wűrzburg in Germany. He was one of the leading physicists of his time after having published almost fifty scientific papers on various researches in physics. His most important contribution to science and mankind however was destined to be made on November 8, 1895, when he discovered *A New Kind of Rays,* which he called x-rays. After seven weeks of most intense studies of the properties of these new rays, Röntgen handed his preliminary communication on his discovery to the secretary of the local Physical-Medical Society and it was published at once in the Sitzungsberichte of this society on December 28, 1895.

Within a few days, the news of this phantastic discovery was cabled to the four corners of the world and Röntgen's findings were verified in numerous laboratories. A curious world learned that the discoverer was fifty years old, that he had been born in Lennep, Germany, but had received his early education in Holland and his college training in Switzerland. He had occupied the chairs of physics at Hohenheim and Giessen Universities before being called to Wűrzburg in 1888 where the great discovery was made. After the news of the discovery reached the public, Röntgen almost overnight became the focus of international praise and curiosity. On March 9 Röntgen succeeded to publish his second communication on *A New Kind Of Rays, Continued,* despite daily interruptions of his work by curious and interested people alike. A year later, the third and last communication *Further Observations on the Properties of X-rays* appeared, closing Röntgen's case presentation on his discovery. These three communications have become models for recording scientific investigations with accuracy, brevity, and simplicity.

Of the honors traditionally awarded distinguished men who become public figures, Röntgen received a lion's share: Honorary degrees, diplomas, prizes, and medals were showered upon him, and numerous monuments were erected to his memory. Of immense satisfaction to him was that for twenty-eight years, until his death on February 10, 1923, he was able to follow the great developments of his discovery.

* Cleveland Clinic, Cleveland 6, Ohio. Received for publication November 9, 1945.

Now after fifty years an astounding development of roentgenology has taken place. Röntgen's little fist size tube with which he discovered the x-rays has grown to giants many yards long and carrying voltages up to several million volts, yes, even to new type generators like the betatron which produces energies equivalent to 100 million electron volts. Röntgen's little induction coil has made place to powerful generators to supply the voltages necessary for the production of most penetrating and most powerful x-rays. Röntgen's little fluorescent screen has made place to precision photo-fluoroscopes with which mass surveys of thousands of patients or healthy individuals can be made in short time. Röntgen's observation of the ability of his rays to ionize the air and thus making it electrically conductive has led to the international adoption of the ionization method to measure x-rays and to the dosage unit "roentgen" or "r" which has been internationally accepted. Röntgen's absorption measurements have led not only to the evaluation of any "shadow" picture but also to the introduction of contrast media into the body to outline numerous organs such as the stomach and intestines, the kidney, the gallbladder, parts of the brain and others. Industrial radiography rivals clinical radiography and there is hardly any science, art or industry in which the use of x-rays does not play an important role. Truly a marvelous development of a great discovery.

Röntgen would be pleased with this state of affairs at the golden jubilee of his discovery. He also would be happy to know that Major Etter, a Pittsburgh radiologist with the U.S. Army of Occupation in Germany found in September 1945 that the old Physical Institute in Würzburg, where the discovery of the x-rays was made is hardly damaged, although the rest of the university is broken walls, stark chimneys and broken windows,—and that in all this war damage, the old shrine with Röntgen's original equipment, tubes and mementoes such as the Nobel prize certificate and other invaluable material is intact.

For greater details see Glasser, Otto. Dr. W. C. Röntgen. Springfield, Ill. Thomas, 1945.

Salon Announced

The Chicago Historical Society announces the selection of Edward C. Crossett, FRPS, Adolf Fassbender, FRPS, FPSA, and Rowena Fruth, FPSA, to judge the Fifth Chicago International Salon of Photography which will hang in the Charles B. Pike Print Rooms of the society from January 20 to February 22, 1946. The closing date for entries will be January 9, 1946. Further information may be obtained from the Chicago Historical Society, Clark street at North Avenue, Chicago 14, Illinois.

Association News

WANTED BY MEMBERS

A Contax Camera and accessories, for medical photography.

A Micro-Ibso attachment, for photomicrography.

If you have any idea where the above can be obtained, please send details to Miss Anne Shiras, University Office, Magee Hospital, Pittsburgh 13, Pa.

1945 CONVENTION — NEW YORK

There were good reasons for meeting in New York City this fall, so it was chosen even though we realized it would be crowded. We had not realized however that General Wainwright would be receiving a welcome there just as the convention assembled; nor that such large numbers of the armed forces would besiege the hotels. Some members will long remember the New York Convention as the one where they had to spend the first night sitting up, in spite of reservations secured several weeks ahead. And the Salon committee will not soon forget the moment when, loaded with prints, viewing boxes and other paraphernalia, it discovered that the room for the Salon was being converted into a dormitory with beds for some twenty-five people! However, the Salon did get hung, everyone did have a room after a while, the meeting was an interesting one and the members approved the Board's decision to meet this year, even under difficulties.

Amendments — The Membership Year; Fellows of the B.P.A.

The annual meeting was held Thursday morning, September 13, at 11:30 A.M. The main business before the meeting was the proposal of two constitutional amendments; one discontinuing the present membership year of July 1 to June 30 for incoming members; the other, creating a grade of membership to be known as Fellows of the BPA. The first created little discussion. It was decided to begin our fiscal year as of September 1st, since the first number of a new Journal Volume is published then. The year will be divided into four quarters, beginning September 1st, December 1st, March 1st, and June 1st, respectively. Each new applicant will begin his membership as of the first of the new quarter after his application has been received, and will continue for a year from that date. In case his Journal subscription thereby begins in the middle of a volume, he will be told how the first numbers of the current volume can be ordered.

As to the Fellowships, there seemed to be complete agreement that such a grade of members should be created. The only subjects for discussion were how applicants should be proposed and what the speci-

fications should be. Some of the members felt that a candidate should be proposed only by existing Fellows, while others thought that the way should be left open for members to apply themselves. If candidates are to be proposed by existing Fellows the question of course came up as to how the first group of Fellows would be created. Mr. Harding explained that a Committee had been formed to consider the matter of Fellowship (see this Journal, 13:169, June 1945) and that this Committee would propose the first group of Fellows. Each name in the group would be considered by the Board of Directors, just as all subsequent proposals, made annually, would be considered by the Board. Mr. Harding said that the first group would not contain everyone thought worthy of consideration for Fellowship; but rather would consist of members who by now would be Fellows if such a grade of membership had existed from the beginning.

Various suggestions were made about qualifications; that a specified length of membership should be named and that certain standards should be maintained which could not be varied to suit the tastes of any particular group of Fellows and Directors. On the other hand, the point was made that certain of the specifications must be kept flexible because of the wide variety of conditions under which our members worked, depending on their fields and specialties, etc. Mr. Arthur Smith stated that he had cast the only opposing vote when the final count on creating Fellowships was taken at the Board meeting, because he felt the specifications should include, besides a stated term of membership, a stated number of major contributions to the Journal, the preparation of a special article of not less than 10,000 words, and unanimous election by the Board.

No attempt was made to formulate specifications and vote on them at the Business Meeting. Dr. Richards stated that the Board had waited to propose Fellowships until it felt the time had come when the title would really mean something. The Directors had given the matter careful consideration and would continue to do so in working out the details. He moved that the amendment creating Fellowships be accepted as read. The motion was seconded and carried, Mr. Smith dissenting.

Round-Table Discussion on the Training of Biological Photographers

An interesting meeting was held on Thursday evening, September 13th. It was a pleasure to have several members of the newly formed Association of Medical Illustrators with us for this discussion. Mr. Tom Jones, President; Mr. W. C. Shepard, Vice President; Miss Muriel McLatchie, Secretary; Miss Elizabeth Brodel, Treasurer; and Mr. Elon Clark,

Chairman of the Board of Governors, were all present. Mr. Jones spoke on the proposed Institute of Visual Education, to be formed by the Medical School of the University of Illinois. Both he and Mr. Clark stressed the fact that a photograph must be more than technically successful to be a true illustration; the photographer must know the purpose behind the photograph and how to portray it, and therefore must have some knowledge of science and of basic principles. Mr. Jones said the course would probably be a two-year one. It would be up to the BPA to help determine what photographic subjects should be taught, how many photographers it would be wise to train at a time, etc.

Mr. McComb, Chairman of the Curriculum Committee, read some of the outlines of study submitted by his committee, and other members. About 75 per cent of the suggested subjects concerned photographic technics. The rest dealt with science and art.

No attempt was made in the meeting to formulate and vote on a curriculum. The members were apparently agreed that a course of training was desirable and that a center such as the Institute would advance biological photography as a science and a profession. Their discussion centered mainly around how much science and art the photographer should study. They pointed out that whereas an artist must begin with blank paper and create a specimen, the camera does the drawing for a photographer and therefore he can get along with far less knowledge of anatomy. The amount of time that could be spent on science and art would depend on what students take the course. If they had already had photographic experience they could of course take more time rounding out their training than students who had all their photography to learn.

The suggestion was made that the Institute should not only take students for basic training, but should be available for refresher courses; and for the study of special problems in visual education. Also that it should not be confined to medical work but cover the larger field of biological illustration.

Election of Officers

The report of the Nominating Committee was read Thursday afternoon, September 13, as follows:

President ----------S. J. McComb
Vice President ----------L. P. Flory
Secretary ----------Anne Shiras
Treasurer ----------Stella Zimmer
Directors----J. Carlile, A. W. Proetz, M.D., L. E. Varden

The elections were held on Friday, September 14 at 11:30. It was moved and seconded that the Secretary be instructed to cast one ballot

for the entire ticket. The motion was passed unanimously. As the election of Mr. Flory to the Vice Presidency left a vacancy on the Board, Mr. J. B. Haulenbeek was appointed to fill his place.

Medical Visual Education

At the Pittsburgh meeting of the Association of American Medical Colleges, Oct. 29-31, one of the sessions was given over to "Visual Education." Mr. Tom Jones and Mr. Lewis Waters spoke on the training necessary for medical illustrators and photographers if the full possibilities of medical visual education are to be realized. Other educators and public health officials discussed teaching methods, stressing motion pictures in particular.

The speakers did not agree on all the details of teaching with visual aids. Some preferred silent films, and thought it better for the lecturer to discuss the film as it went along rather than to rely on a "canned talk." Others thought sound-films better, if followed by a discussion between teacher and students. All seemed to agree that we need central clearing-houses for films in various fields of medical work, and critical evaluations of the films available.

This idea of film deposits has been discussed by many scientific groups, in other countries as well as our own. It raises a good many problems and for that reason though the discussions are many, the film centers are few. The need for them is obvious and an increasing number will doubtless be formed. It seems a worthwhile project to study those in operation and to discover how the various societies are solving the problems of formulating standards, and creating boards to apply those standards.

Program of the 1945 Convention

THURSDAY, SEPTEMBER 13, 1945

9:00-10:00 A.M.—Registration

10:00 A.M.—President's Address: (X-Ray Reproductions)
Ferdinand Harding, Children's Hospital
Boston, Mass.

10:30 A.M.—Photography as an aid to Scientific observation.
H. Lou Gibson, Eastman Kodak Co.
Rochester, N.Y.

11:00 A.M.—Star in Stripes & Our Younger Generation.
Sam C. Dunton, New York Zoological Park

11:30 A.M.—Business Meeting
Recess for Lunch

2:00 P.M.—Undersea Photography.
Mr. Vincent Palmer, Marine Engineer
of Vincent Palmer & Co., N.Y.

2:30 P.M.—Photography of Gross Specimens.
John J. Beiter, Rochester General Hospital
Rochester, N.Y.

3:00 P.M.—Coated Lenses in Biological Photography.
Lorus Milne, Jenkintown, Pa.

3:30 P.M.—Relation of Light to Scientific Accuracy.
Arthur L. Smith, Cornell University, N.Y.

4:00 P.M.—The Commercial Exhibit Time.

8:00 P.M.—Round-Table
Discussion on the Education and Training
Requirements for Scientific Photographers

FRIDAY, SEPTEMBER 14, 1945

9:30 A.M.—High-Speed Motion Picture Photography
with 16 Mm Films.
Henry M. Lester, 101 Park Ave.
New York, N.Y.

11:00 A.M.—Visual Education.
Dr. Arnspiger, Encyclopaedia
Brittannica Films Inc., N.Y.

11:30 A.M.—Election of Officers
Recess for Lunch

2:00 P.M.—Phase Difference Photomicrography.
Dr. O. Richards, Research Biologist
Spencer Lens Co., Buffalo, N.Y.

3:00 P.M.—Vectographs.
Mr. Robert Hall Morris, President
Heliotype Corp., Cambridge, Mass.

3:30 P.M.—The Application of Evaporated Films to Partial
Reflectors & Filters.
J. Butterfield, Bausch & Lomb Optical Co.
Rochester, N.Y.

4:00 P.M.—Picture Exhibit

8:00 P.M.—Annual Banquet
North Ballroom, Hotel New Yorker

SATURDAY MORNING, SEPTEMBER 15, 1945

10:00 A.M.—Trip Through the Pavelle Lab., Inc.
533 W. 57th St.—Leave Hotel New Yorker—
9:30 A.M.

11:00 A.M.—Methods of Taking Pictures without High-lights.
Dr. Hans Freivogel, 42-11 Kissena Blvd.
Flushing, N.Y.

The following firms had displays in the Technical Exhibits:
Clay-Adams Co., New York 10, N.Y.
Eastman Kodak Co., Rochester, N.Y.
Gamma Instrument Co., Inc., New York 16, N.Y.
Photovolt Corp., New York 16, N.Y.
Weston Electrical Instrument Corp., Newark 5, N.J.
Fairchild Camera Corp., New York, N.Y.
Spencer Lens Co., Buffalo 11, N.Y.
Heliotype Corp., Cambridge, Mass.
Ansco, Binghamton, N.Y.
Defender Division of Dupont, Rochester, N.Y.
Adel Precision Instrument Co., N.Y.

B.P.A. Officers and Committee Chairmen

President ---------- S. J. McComb
Section of Photography
Mayo Clinic
Rochester, Minn.

Vice President ---------- Louis Paul Flory
Boyce Thompson Institute
for Plant Research
Yonkers 2, N.Y.

Secretary ---------- Anne Shiras
University Office
Magee Hospital
Pittsburgh 13, Pa.

Treasurer ---------- Stella Zimmer
Photographic Department
School of Medicine
Syracuse University
Syracuse 10, N.Y.

Editor of Journal ---------- Leo Massopust
Marquette University
Milwaukee 3, Wis.

Motion Picture Committee	Dr. Oscar Richards Scientific Instrument Div. Buffalo 11, N.Y. American Optical Co.
Public Relations Committee	Dr. Arthur W. Proetz 1010 Beaumont Building St. Louis 8, Missouri
Committee for Cooperation with the Army	Major Ralph P. Creer Army Medical Museum Washington 25, D.C.
Annual & Traveling Salons	Nathan S. Horton New York 16, N.Y. 22 E. 40th St.
Questionnaire Chairman	Arthur L. Smith Photographic Science Serv. Cornell University, Ithaca, N.Y.
Curriculum Chairman	Stanley J. McComb Mayo Clinic Rochester, Minn.
Committee on Fellowships	Dr. Arthur W. Proetz 1010 Beaumont Bldg. St. Louis 8, Mo.

Sustaining Members

Some individuals who have a deep interest in the advance of scientific photography help finance a wider range of activities for the Association by becoming Sustaining Members.

Bell, Dr. Dennistoun M.
"Broadview"
Amagansett, N.Y.

Brubaker, J. D.
805 Greenleaf St.
Evanston, Ill.

Cammon, W. A. "Don", D.O.S.
Cameron Surgical Specialty Co.
666 West Division Street
Chicago 10, Ill.

Hill, Thos. T.
Edwal Laboratories, Inc.
732 Federal St.
Chicago 5, Ill.

Horton, Nathan S.
Ayerst, McKenna & Harrison, Ltd.
32nd floor 22 E. 40th St.
New York 16, N.Y.

Johnson, L. R.
1700 Standard Building
Cleveland 1, Ohio

Copeland, Barney
Barnett Optical Laboratories
1218 Pratt Blvd.
Chicago 26, Ill.

Davidson, Emil
Clay-Adams Company
44 West 23rd St.
New York 10, N.Y.

Elder, George S.
U.S.S. Sevier
c/o Fleet P.O., N.Y.

Fairchild Camera & Instrument Co.
W. J. Schubert
475 Tenth Avenue
New York 18, N.Y.

Flory, Louis Paul
Boyce Thompson Institute
for Plant Research
1086 Broadway
Yonkers 2, N.Y.

Garner, Dr. Jay M.
723 Elm Street
Winnetka, Ill.

Gravesen, Lt. Alex A.
367 Graphic Blvd.
River Edge Manor, N.J.

Gibson, H. Lou
Eastman Kodak Company
343 State Street
Rochester 4, N.Y.

Hagaman, R. S.
Defender Photo Supply Co.
Rochester 3, N.Y.

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101 Park Avenue
New York 17, N.Y.

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1721 Bushnell Avenue
S. Pasadena, Calif.

Varden, Lloyd E.
Pavelle Laboratories
533 West 57th Street
New York, N.Y.

Waters, Lewis
Department of Medical Art and
Visual Education
Southwestern Medical College
3802 Maple Avenue
Dallas 4, Texas

Zbinden, Theodore
412 Colton Building
Toledo 2, Ohio

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Oculars Comp. 7½X, 10X, 15X.
1.40 B & L Aplanatic Condenser with Iris.
List Price $295.25_____Sell all $200.

Will take f.4.5, 13.5 cm Carl Zeiss Tessar, Rim Set Compur Shutter as part trade. For further information write to Gustav A. Haupt Jr., (Member, BPA) 127 North Fourth Avenue, Coatesville, Pa.

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Leo C. Massopust, Editor

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MARCH, 1946

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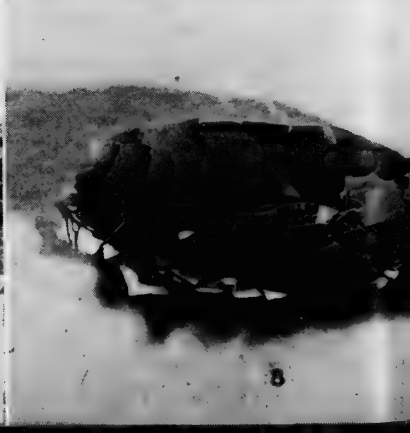


8

High-Speed Motion Picture Photography

Henry M. Lester *

BIOLOGISTS who have longed for the power to stay that fleeting crucial instant in the life cycle of a living organism can now look to a revolutionary new technic: high-speed cinephotography. It affords, in effect, the advantages of a "Time Microscope" with certain additional benefits. It magnifies seconds of action to minutes of observation, perpetuates motion in record form, produces living pictures.

Through its use, those infinitesimal movements which combine to produce action, however fast, become comprehensible to human eye and brain. Minute life forms are heroically cast in a large-scale screen drama viewed, not by a solitary eye peering through the microscope, but by the group. The biological passing show is permanently recorded, either in natural color or black-and-white, for convenient and repetitive study. Now both motion pictures and sequential still photographs augment the scientific record.

For the benefit of those who by now may have begun to fear that any discussion of cinephotography necessarily involves stupendous, colossal, Hollywoodian claims which must be discounted for accuracy, it should be explained that these accomplishments are part of the history of World War II. The war produced large-scale research needs. Among the tangible answers in the photographic field was the development of a

Received for publication January 28, 1946.

* Editor *Photo-Lab-Index*, 101 Park Avenue, New York 17, N.Y. Presented at Fifteenth Annual Convention of the Biological Photographic Association, September 14, 1945, at New York, N.Y.

LEGEND FOR FRONTISPIECE

Egg-eating Snake, Dasypeltis scaber, of South Africa. It can swallow an egg 3 or 4 times the diameter of its head . Photographs were made in a glass fronted cage with flash bulb illumination. Glass was removed as soon as the snake exhibited interest in the egg.

1. Inspecting the "prey." 2. The jaws start to expand. 3. Almost half-way there. 4. On the home stretch. 5. The cutting processes start. 6. The egg has collapsed . 7. The shell is regurgitated .8. What is left of the shell. Titles through the courtesy of "Animal Kingdom", November-December 1945.

See "Flash Technic in Snake Photography," Pages 128-129.

combination of high-speed motion picture camera, continuous flash lighting, and synchronized control of camera, lights and action.

LIGHT WITHOUT DETRIMENTAL HEAT

While research for the armed forces was conducted largely in fields other than biological, requirements are not greatly different. The advantages of this new equipment and technic are mutually applicable.

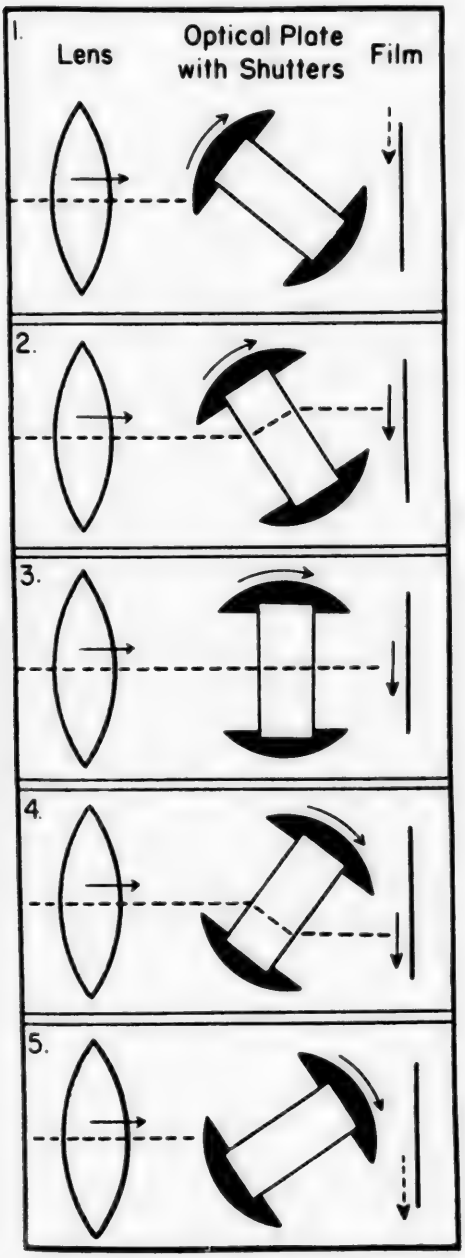
Figure 1. Continuous flash lighting unit complete with parabolic reflector and ready for operation, with connection to power control box and its cable leading directly to camera.

For instance, motion pictures of life action can be made at exposures of 1/15,000 second. Subject illumination exceeds 3,000,000 lumens, or better than four times the brilliance of July sunlight. Small diaphragm apertures, made possible by such intense illumination, assure pictorial depth and definition, as well as even, brilliant lighting.

Of especial interest is the present possibility of using high intensities of light without injurious heat effects upon sensitive subjects. Maximum light with minimum heat has been rather a paradoxical goal, but science recognizes workable solutions. While the elimination of the heat attendant upon light still may be impossible, its effects can be dissipated or minimized with results entirely satisfactory. In short, with continuous flash lighting, any living organism whether insect, reptile, or animal, whether tissue or cell, may be photographed under conditions which border upon 100 per cent favorable.

MAGNIFICATION OF TIME

Knowledge that motion picture equipment can be used to magnify time and motion just as the microscope magnifies size has invited scientific interest and application for some years. Conventional motion picture cameras, however, are capable of only a small degree of time magnification, generally about 8×.



The image-forming light ray entering the lens from the left is prevented from reaching the film by opaque end parts acting as a shutter. (Figure 1)

As the shutter and optical glass plate rotate, the light enters the glass plate. Due to the angle at which light enters, it is refracted upward. Upon leaving the glass plate, the light is bent again and so reaches the film at the top. (Figure 2)

As the optical plate rotates, the angles of entry and exit of the light, and consequently the degree of displacement, become less until the glass plate reaches an exact vertical position, at which point the light ray passes without deflection. (Figure 3)

As the plate continues to rotate, the angles of entry and exit of the light become greater with the result that the image continues to be shifted downward (Figure 4) until the shutter cuts off the light ray. (Figure 5)

As the image shift is continuous and at the same rate of speed and direction as the film movement, a relatively stationary image is produced for a brief period of time.

NOTE: *For clarity's sake, only one ray of light is shown to illustrate the principle of optical compensation for continuous film movement.*

Figure 2. Optical Compensation for Continuous Film Movement in the Eastman High-Speed Camera Type III

Further magnification has been blocked by speed limitations of the ordinary cameras' intermittent film movement. This mechanism brought the film to a quick but complete stop during exposure, an operation poorly suited to high speeds even were the film capable of withstanding the stresses and strains.

This barrier was detoured by developing a camera system whereby the film could move continuously, driven by a motor, and by applying

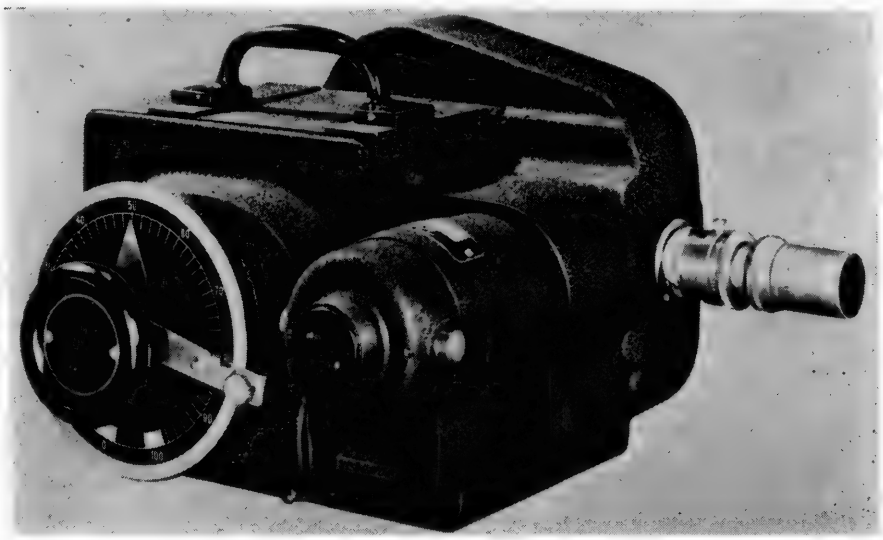


Figure 3. Eastman High-Speed Camera, Type III, with speed indicator dial and motor in front. Film chamber rises in back behind lens.

the optical principle of image transport. In high-speed motion picture cameras, an optical flat fitted with opaque ends rotates synchronously between lens and film. By refraction in the optical flat, subject image and film move in the same direction at the same speed, and, consequently, are stationary in relation to each other.

Film passes through the camera at speeds above 50 miles an hour. The opaque ends of the optical flat function as shutters. One complete roll, or 100 feet of 16mm film passes through the camera in a little over one second. In that time, given adequate illumination, action is recorded at the rate of 3,000 frames per second.

200× MICROSCOPE OF TIME

The high-speed camera does for the time dimension what the microscope does for the spatial dimension. Projected at the normal rate of 16 frames per second, the film depicts fast action in slow motion. The microscope magnifies objects too small to be seen with the eye alone. The camera magnifies movements too fast for direct observation. However, high-speed cinephotography can produce magnification not alone

of time, but of movement and size as well, by virtue of enlarged projection on the screen.

These potential contributions of high-speed cinephotography to biological research have been handicapped not only by limitations within the camera, but by unsatisfactory and inadequate illumination and by difficulties of application. The major problem has been to provide suf-

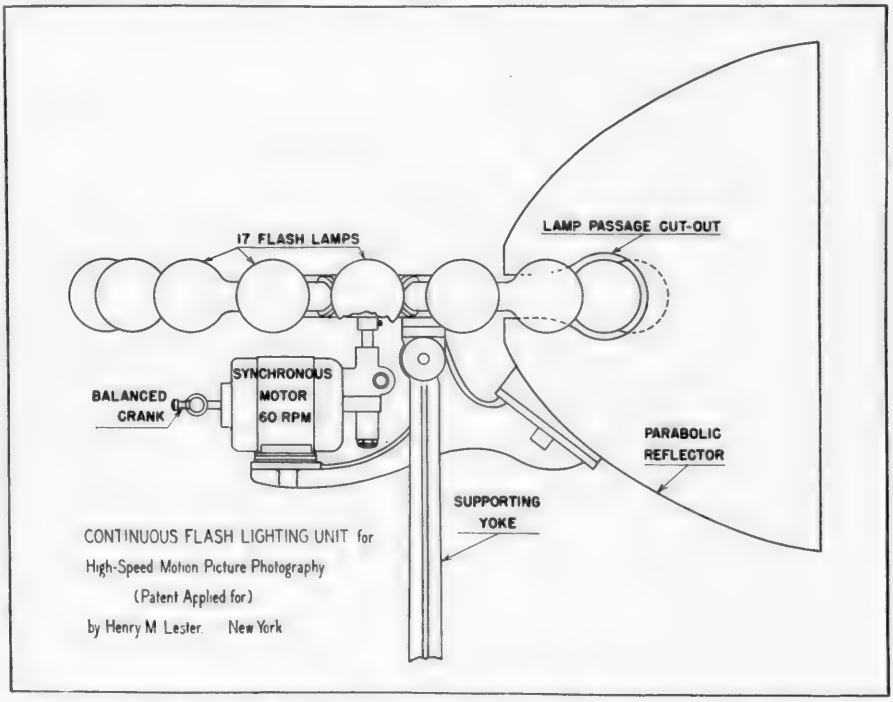


Figure 4. Side view of continuous flash lighting unit showing relationship of lamps, motor and rotor on adjustable supporting yoke.

ficient illumination to accommodate necessarily short exposures without simultaneously producing heat so excessive as to damage subjects, introduce annoying research variables and roast the photographer.

Minor, but no less troublesome coincidental problems, have included large-scale consumption of electric current, frequently requiring additional power sources. Heavy, bulky apparatus hung with heavy, complicated conductors and connectors, occupied space which could ill be spared. Hours of expert engineering formerly went into preparation.

Overheating of Subjects

Progress in illumination can be appreciated the more when it is recalled that flood light customarily recommended for high-speed cinephotography actually produce the effects of therapeutic heat lamps. The

subject is caught in the superimposed beams of at least four lamps, sometimes more, located only inches away.

Under such conditions, cinephotographic studies of living organisms must be annoyingly brief. Furthermore, these over-volted lamps operat-

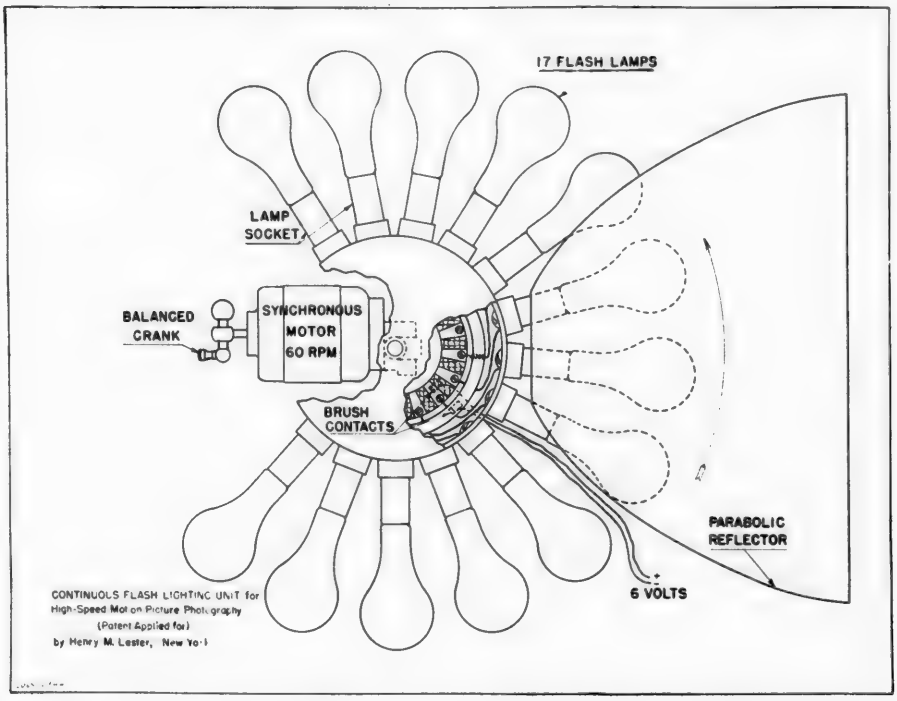


Figure 5. Top view of continuous flash lighting unit diagramming connection between lamps, rotor and motor.

ing at high color temperatures rapidly lose actinic value with each step decline in voltage. Current consumption, which must be maintained, is around 20 amperes at 115 volts for four such lamps.

The overall problem obviously resolves itself into two phases: creating great light intensities without excessive heat; and synchronizing camera, lights and action. At the same time, the equipment must incorporate reasonable simplicity of construction and operation, the first to conserve space, the second to enable the operator to devote his attention largely to the subject.

New Illumination Equipment

These requirements are fully met by high-speed cinephotographic equipment built about a continuous flash lighting unit developed by the author. Photoflash lamps, revolving through parabolic reflectors, direct brilliant light upon the subject with a brevity of flash and a rush

of air currents which dissipate heat. Furthermore, the lamps can be operated at a sufficient distance from the subject to preclude any ill effects from heat. Power requirements are met by ordinary household current and a 6-volt dry-cell battery to fire the lamps. Adjustments are simple. The equipment is portable. In use, it occupies limited space refreshingly free from spiderwebs of cables.

This equipment produces not only brilliantly illuminated slow-motion pictures in which time and size are magnified, but also acceptable sequential stills so valuable for detailed analysis. These still photographs, taken at the rate of 3,000 frames per second, trace movement in its every detail from inception to conclusion and are often suitable for publication.

The Camera

While various high-speed motion picture cameras are applicable, this equipment employs the 16mm Eastman High-Speed Camera, Type

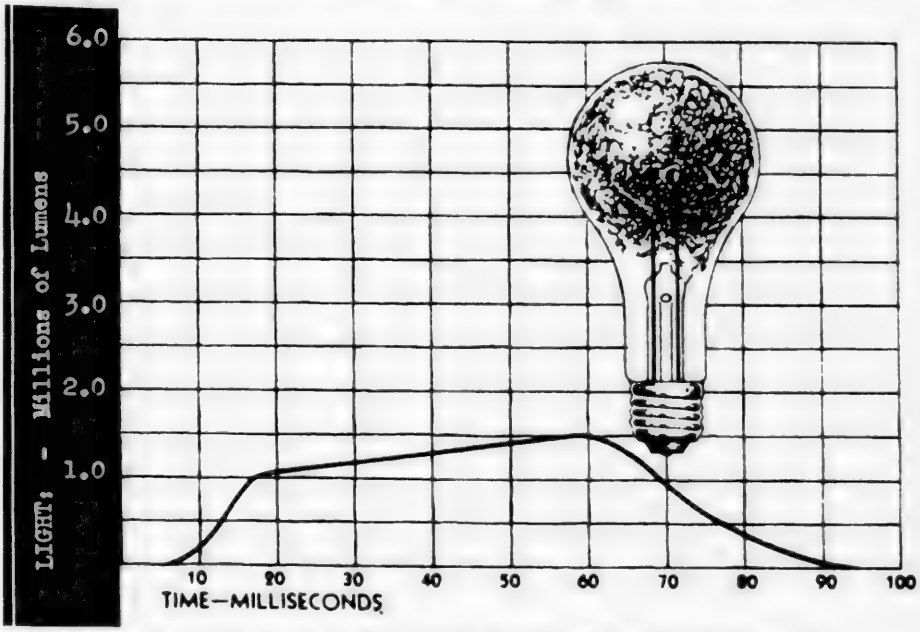
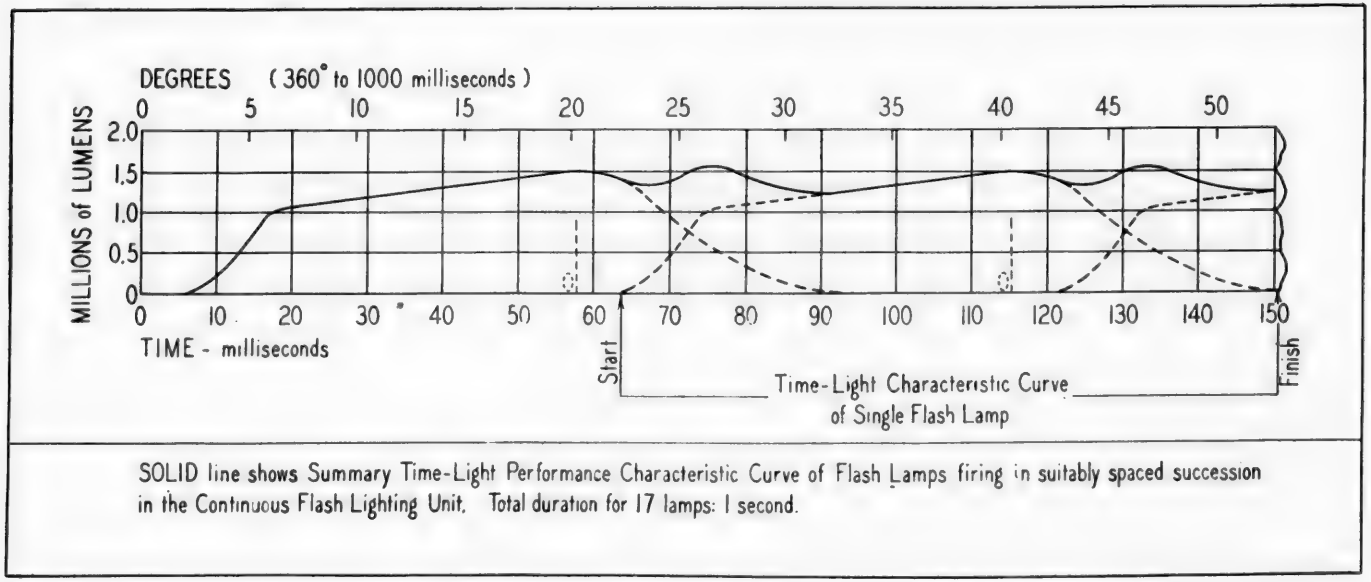


Figure 6. Light curve of Focal plane Mazda Photoflash lamp No. 31.

III. It has certain advantageous features. Film moves continuously through the film gate at speeds reaching a peak of 51 miles per hour.

Opaque ends of a rotating flat function as shutters by intermittently interrupting passage of light from lens to film. The film is exposed, at speeds as high as 1/15,000 second, during approximately one-fifth of the picture cycle.

A preset indicator determines the maximum speed to be attained by the film and automatically establishes the rate of acceleration. Ap-


DEGREES (360° to 1000 milliseconds)
0 5 10 15 20 25 30 35 40 45 50
MILLIONS of LUMENS
2.0
1.5
1.0
0.5
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
TIME - milliseconds
Start
Finish
Time-Light Characteristic Curve
of Single Flash Lamp
SOLID line shows Summary Time-Light Performance Characteristic Curve of Flash Lamps firing in suitably spaced succession in the Continuous Flash Lighting Unit. Total duration for 17 lamps: 1 second.

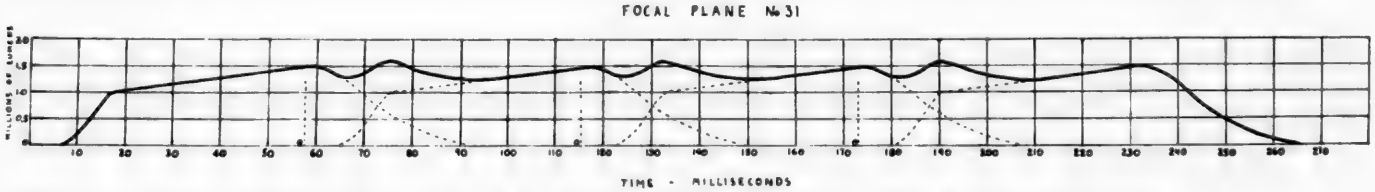


Figure 7. (Above) Characteristics of initial two lamps firing in continuous flash lighting unit cycle.
Figure 8. (Below) Representative light curve for entire 17 lamp cycle of continuous flash lighting unit, showing constant light output.

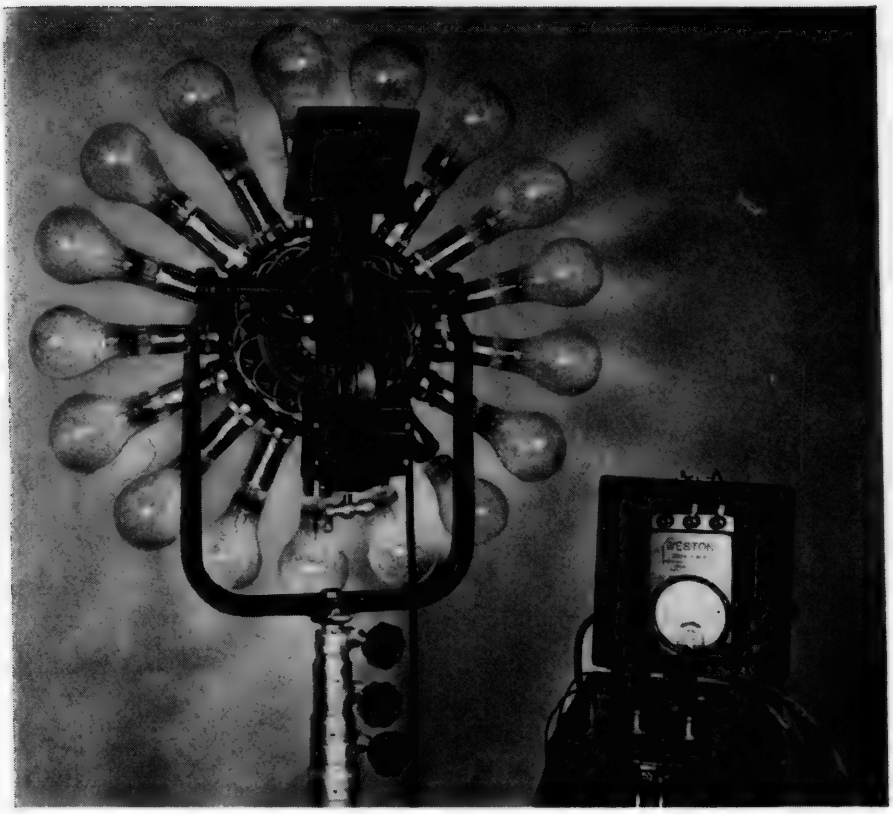


Figure 9. Continuous flash lighting unit in vertical position, with reflector removed to show internal connections. Cable connects with power control box containing 6-volt dry-cell battery which fires lamps.

proximately 80 per cent of full speed is reached within 25 feet of film. Thereafter acceleration gradually increases until the film is passing the lens at a rate of 3,000 frames per second.

Built-in features of the Type III camera, making it particularly satisfactory for use with continuous flash lighting, is a sensitive Microswitch connected with the film footage indicator. Preset to activate an external electric circuit at any desired point on the film after the camera is started, this Microswitch flashes the lamps at that instant in which film movement and subject action reach desired peaks.

The Lights

Two continuous flash lighting units are customarily used. Each consists basically of a parabolic reflector mounted upon an adjustable stand supporting a bracket holding flashing rotor driven by a synchronous reducer motor. The rotor consists of an 8 inch wheel. To its circumference

are attached thin-walled, spring-loaded sockets accommodating 17 flash lamps, which move horizontally through a cutout gate in the reflector. Attached to the underside of the rotor, which is revolved once each second by the slow shaft of the reducer motor, is a large-segment commutator serving as distributor for the flashing current.

Each lamp socket makes a brush contact with its corresponding bar on the commutator. Firing order and contact intervals are pre-determined and fixed by the construction of the commutator, but commutator and brushes are adjustable with respect to the lamp sockets to assure consummation of the entire flash within the reflector and to synchronize dual units. Illumination is balanced by adjusting the timing so that the light peaks of one cycle fill the light valleys of the other.

Continuity of Flash

In order to assure even illumination and to reduce the required number of lamps, the Mazda No. 31 Focal Plane Photoflash lamps, made by General Electric Co., and by Westinghouse Electric Co., are used. The No. 2A Wabash Superflash lamp, which similarly has long-flash performance characteristic, is also suitable.

The 17 lamps yield a fairly level output of more than 1,500,000 lumens for a full second. This is sufficient time to expose about 60 feet of film at top speed of 3,000 frames per second. With the average subject, photographed in black-and-white two continuous flash units produce better than 3,000,000 lumens, allowing the use of ranges between f.4 and f.8. With Kodachrome or Ansco Color film, exposure at f.2.7 to f.4 is satisfactory. With color film, however, the lighting units are moved closer to the subject than for black and white footage.

The lamps flash at intervals of 1/17 second, or approximately 59 milliseconds. Initially, there is a 7-millisecond time lag between the closing of the flashing circuit and the start of illumination.

At 10 milliseconds the light level approaches 250,000 lumens, at 14 milliseconds 500,000 lumens, at 18 milliseconds 1,000,000 lumens. There is a slower rise to 1,500,000 lumens, or more, at 59 milliseconds.

At this point contact is made for the next lamp. Its light output starts at 66 milliseconds, or just as the light of the first lamp begins to fade. At 90 milliseconds, the first lamp is extinguished, the second at peak. At 110 milliseconds, firing contact is made for the third lamp, and the system continues throughout the entire cycle.

Figure 10. Henry M. Lester using the Eastman High-Speed Camera, Type III for motion pictures at 3,000 frames per second to study the wing and halteres action of a drone fly. Dorothy S. Gelatt adjusts the power control box for the two continuous flash lighting units, each using 17 No. 31 Mazda Photoflash lamps, and yielding a total light output of 6 million lumens. (Photo by David B. Eisendrath, Jr., at The American Museum of Natural History.)

While a straight-line level of illumination may not be achieved, variation is within 1,250,000 to 1,600,000 lumens, and, therefore, well within the latitude of black-and-white film.

THE CONTROLS

The single power-control unit contains an ordinary 6-volt dry-cell battery as current source for flashing the lamps; a locking relay, connected to the camera microswitch to maintain battery current through the commutator until all lamps are fired; and two polarized receptacles accepting four-conductor Jones plugs attached to wires carrying both the alternating 60-cycle 115-volt current to the synchronous motor driving the rotor and the 6-volt current to the lamps.

The power-control unit additionally provides for means of starting subject action and firing lamps in any predetermined order. By adjustment, illumination can be started in advance of action to be photographed, or the light units can be flashed at varying time intervals instead of simultaneously.

This equipment occupies little more space than any camera with two light units. It requires connection only with one household electric outlet. It is largely preset, and, once started, permits the photographer to concentrate his attention upon the subject.

ADAPTABLE OPERATION

Speed of camera operation is determined by subject action. Rapid movements may require adjustment of the equipment so as to delay illumination until the camera is at peak speed, or after 75 feet of film have run through. In such extreme cases, only 25 feet of film will be exposed. However, projected slow-motion films prolong the action even of only 25 feet to nearly one minute of observation. While that may seem to be a brief time for study, it should be remembered that the eye will be viewing action which actually has taken place in a fraction of a second and which would otherwise be an unintelligible blur.

With many subjects in biological research, substantially less than top operating speeds produce better results. The slower the camera speed, the earlier the illumination, and the more film exposed. In fact, several exposures sometimes are preferable, especially when relatively slow subject action permits only part of a full cycle to be recorded on 60 to 75 feet of film. Film editing and joining then facilitate presentation of a moving record of the complete, uninterrupted cycle.

Operating costs represent expenditures for lamps and film of roundly $12.00 per exposure. This cost is small in view of such advantages as recording and viewing motion too fast for the eye, and of producing high-quality time-motion studies and sequential stills for convenient, leisurely, and repeated analysis.

Experience In Low Magnification Kodachrome Photomicrography

S. I. Kornhauser *

THE present paper deals with the photography of microscopic slides with the simple microscope giving magnifications of from two to fifteen diameters. Previously[1], I described my experience with the use of the compound microscope employing optical combinations giving magnifications of 20 to 640 diameters. This paper is a supplement to the previous one and much of the equipment is the same as that previously employed and described.

The Camera

The camera, figure 1-*1*, is a Century four by five with lens board and shutter. The focusing glass and its holder were removed and a piece of quarter inch masonite painted dull black fitted light-tight in the back. Strips were riveted to the masonite so that Eastman Miniature Kodachrome Adapter No. 33, figure 1-*2*, could be slid in and out with ease. When slid in, the optical axis of the camera centered on the focusing glass of the adapter. An opening 40 x 50 mm was cut in the masonite directly beneath the opening in the adapter base plate. When the adapter is slid out, the light meter is placed on the opening in the masonite to calculate the exposure.

The camera is held in place by a tripod screw, figure 1-*5*, passing through a hole drilled in the iron swinging bracket of a Bausch and Lomb K camera. The bracket revolves about the vertical rod, figure 1-*4*, which is connected to the heavy iron base plate figure 1-*3*. There is a camera locating collar on the vertical rod which is tightly secured at a height 297 mm above the level of the microscope stage. This collar is not moved in order to keep the projection distance constant and reduce the number of variables. The heavy iron base rests on four rubber sponges which absorb any vibrations in the room.

Fitting into the front of the camera shutter is a brass adapter ring, figure 1-*8*, its central opening being threaded for standard microscope objectives. The threads on the circumference of the adapter ring can be used as a fine adjustment after focusing with the camera rack and

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* Department of Anatomy, School of Medicine, University of Louisville, Kentucky.
[1] Kornhauser, S. I.: Experience in Kodachrome Photomicrography. J. Biol. Phot. Assn. 12:47-53 (Dec.) 1943.

pinion. The objectives used by the author are shown at figure 1-7. They are the Micro-Tessars and Micro-Summars listed on page 122.

THE MICROSCOPE

The microscope is a Bausch and Lomb stand, figure 1-6, with 36 mm circular stage opening and a brass sleeve condenser holder beneath this opening. There is a plane and concave mirror but the plane mirror only is used.

The condensers, figure 1-9, have focal lengths of 16, 32, 48, and 72 mm and can be focused vertically by threads in their mounts which fit the brass sleeve snugly. Two small holes drilled opposite each other near the bottom of each condenser mount and accommodating a short length of a steel knitting needle, serve well in removing the condensers and mounts from the brass sleeve.

The microscope and camera are kept exactly aligned at all times and ready for use. The alignment was obtained by using a pinhole aperture in the center of the stage opening and moving the microscope stand so that an image of this opening fell in the center of the focusing glass of the adapter. This position was marked on the iron base, figure 1-3, and a piece of one-eighth inch masonite was cut out on a jig saw to fit the forked base of the microscope exactly. This was fastened to the iron base with screws and lock washers so that the marked position of the microscope base coincided with the cut out area of the masonite. If then this piece of masonite and the camera locating collar are not tampered with, the apparatus is easily realigned even if the microscope or the camera are removed from their usual places for cleaning or adjustment.

ILLUMINANT AND ACCESSORIES

The illuminant and its control is the same as previously described[1]. It consists of a Bausch and Lomb Research Microscope lamp, figure, 1-11, with 108 watt 6 volt ribbon filament bulb. The lamp is used at a distance of 34 cm from the center of the microscope mirror. The transformer, figure 1-12, the Bradley-Stat, type 22, figure 1-13, and the Triplett No. 335 volt-meter, figure 1-14, are all mounted together on small movable wooden stand. The Bradley-Stat varies the flow of current to the transformer and the volt-meter indicates the filament voltage. The advantages of this arrangement were previously described[1].

To avoid any shutter jar and to aid in ease of manipulation it was found convenient to use a shutter, to time the exposures, which was entirely separate from the camera and its stand. This shutter was mounted on a large lens board, figure 1-15, held by an adjustable clamp, figure 1-16, to a ring stand. The iris opening of the shutter is placed

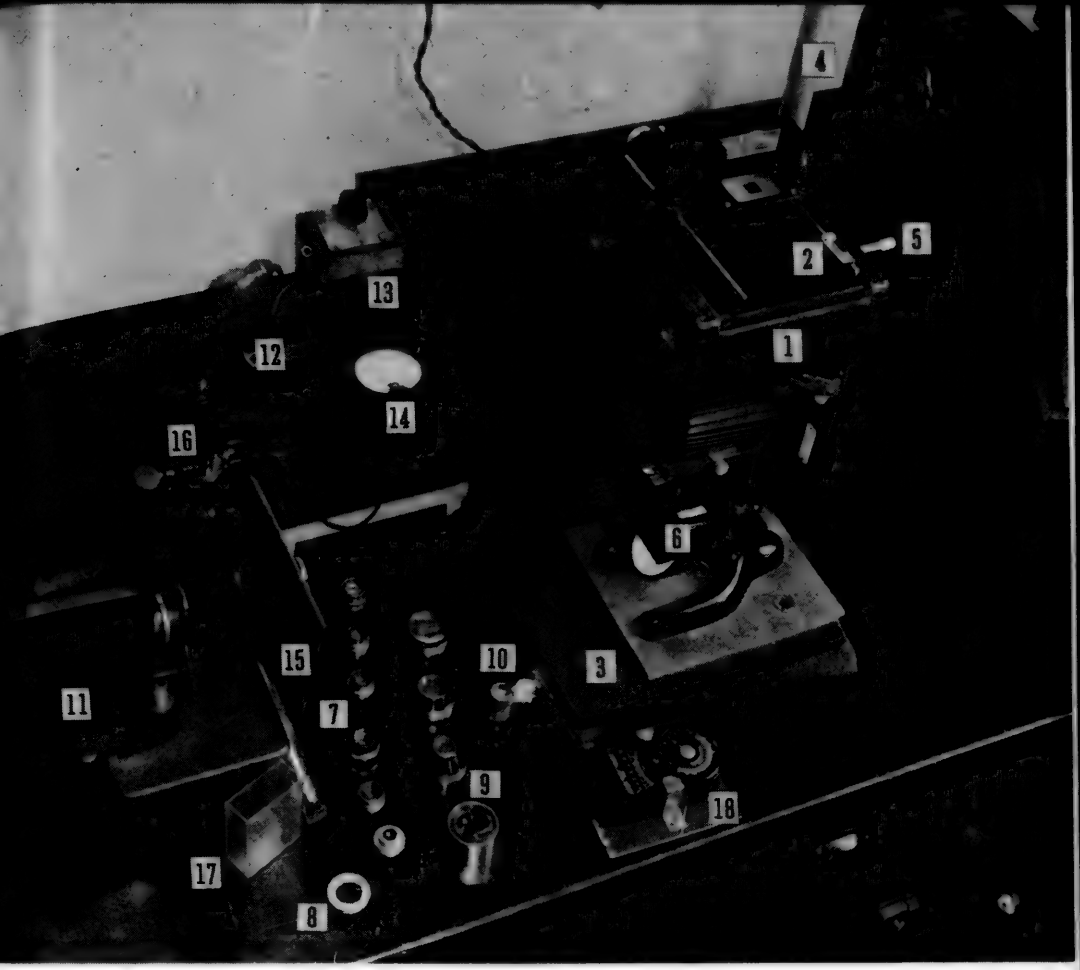


Figure 1.

1. *Camera*
2. *Kodachrome Adapter*
3. *K camera base plate*
4. *K camera supporting rod*
5. *Tripod screw through swinging bracket*
6. *Microscope stand*
7. *Objectives*
8. *Objective adapter ring*
9. *Condensers*
10. *Focusing lens*
11. *Lamp*
12. *Transformer*
13. *Bradley-Stat*
14. *Voltmeter*
15. *Lens board and shutter*
16. *Clamp and ring stand for 15*
17. *Filter tank*
18. *Exposure meter*

just in front of the filter holder of the lamp so the image of the filament on the microscope mirror is in no way interfered with when the shutter is open.

Eastman filters of the CC series are used on the lamp and a filter tank, figure 1-*17*, filled with a neodynium solution is inserted in the tank holder in front of the lamp condensing lenses. A Weston Universal Exposure meter, figure 1-*18*, mounted as previously described[1] is used in calculating the exposures.

USE OF APPARATUS

1. Select a slide showing good contrasting colors. Clean both surfaces thoroughly. Select the area to be photographed under a low magnification using preferably a stereo-binocular microscope. Mark the limits of the desired area with dots of India ink on the cover glass. Measure the area, using a transparent millimeter rule placed beneath the slide on the stage of the microscope. If you have computed the fields covered by your objectives you can then select the one best suited to your object. My own table is given below, figured on a constant projection distance of 297 mm and using Bantam film, (Kodachrome 828A).

Objective	Field in mm	Approx. Magnification
64 mm Micro-Summar	12. x 17.5	2
42 mm Micro-Summar	5. x 8.	5
35 mm Micro-Summar	4.2 x 6.3	6
32 mm Micro-Tessar	3.6 x 5.3	7
24 mm Micro-Summar	2.5 x 4.	10
16 mm Micro-Tessar	1.7 x 2.4	15

2. Select the condenser nearest in focal length to the objective being used.

3. Focus the lamp filament on the mirror. It should almost cover the mirror and a piece of paper placed beneath the condenser should show a broad sharp evenly illuminated image of the filament devoid of color fringes. Work with the voltage reduced to about 5.4 to save your bulb. Illuminate the ground glass of the adapter and focus on the slide with the rack and pinion. Orient the slide and clamp it tightly being sure the area to be photographed is free from any finger marks or foreign matter. Be sure your mirror and substage condenser are giving an even illumination to the entire ground glass. Two methods of checking are useful. Slide out the Kodachrome adapter and examine the objective from the rear, placing a dark neutral filter on the microscope lamp. Open and close the iris of the lamp. The image of this iris should be centrally oriented in the objective. If not, adjust the plane mirror until it is central. Remove the neutral filter and if you have a polished block of uranium glass examine the cone of light between the slide and the front of the objective when in focus. This cone should easily cover the area of your slide to be photographed and should converge toward the optical-center of the objective entering the front element centrally. The condenser can be focused vertically by means of the threads in its mount until the cone is right.

4. Slide in the Kodachrome adapter. Put the proper filter such as CC_4 and the neodynium solution[2] in the microscope lamp and in-

[2] Formula on page 139. Photomicrography. 14 edition. Eastman Kodak Co., Rochester, N.Y. 1944.

crease the voltage on the filament to 6 or 6.2. Check the image again for orientation, evenness of illumination, good color contrast and definition, using a good magnifier on the central area of the ground glass. Focus on the two crossed pencil lines and the small cover glass cemented to the under surface of the ground glass. The author uses a ten times Hastings triplet magnifier in a home made fixed distance mount always in sharp focus on the under surface of the ground glass.

5. Calculate the exposure time by sliding out the Kodachrome adapter and placing the open lens of the Weston meter above the 40 x 50 mm aperture in the masonite back. As explained in a previous paper[1], a reading of 3.2 on the author's meter meant 1/100 second exposure, 1.6 meant 2/100, 0.8 meant 4/100, etc. To reduce the reading if necessary or to make it divide evenly into 3.2, generally close the iris on the microscope lamp or reduce the voltage slightly. Never close the irises on the objectives because that reduces the definition.

6. Having calculated the exposure, the Kodachrome adapter is slid back into place and the final exact focusing is accomplished. Use the threaded outer edge of the objective adapter ring, figure 1-*8*, for the fine adjustment. Blow off any dust which may have settled on the slide. Close the shutter on the board, figure 1-*15*, and set it at 1/100. Gently slide the film into position and expose it the proper number of 1/100 seconds. Move film into the safe position, role off the exposed part. Reduce the voltage on the filament to 5.4 and shut off the lamp. Record in your log book for future reference.

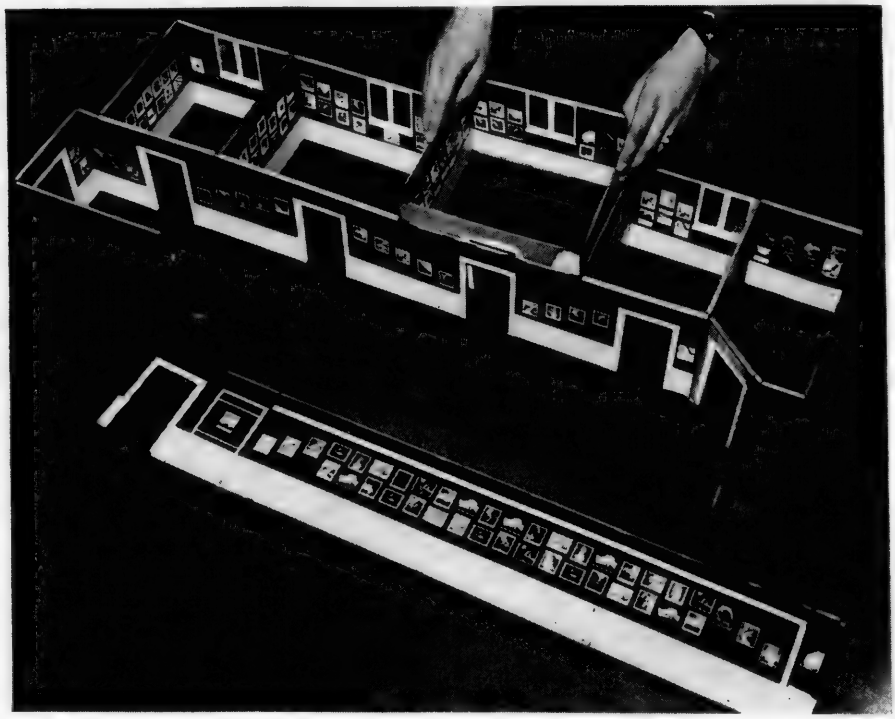
1. Object
2. Objective
3. Condenser
4. Voltage
5. Lamp iris
6. Filters
7. Meter reading
8. Exposure
9. Film Number
10. Exposure Number
11. Result

The low power photographs made by the method described in this paper have added much to the usefulness of the Kodachrome teaching collection in organology and embryology. They give the student a preliminary orientation to the slides subsequently shown with greater magnification. Take for instance the study of sections of the eye. One can first show the whole eyeball in one slide, then in the next the ciliary bodies, the iris, cornea and sclera before proceeding to the details of the retina, choroid, ciliary muscles, etc.

Since the previous paper, the author found that crossed polaroid sheets may be used to advantage both in low and high power Kodachrome microphotography. This is especially true in the study of bone. The introduction also of the neodynium solution has increased the brilliance of the eosins and added to the usefulness of photographs.

Miniature Set Simplifies Hanging Salon

Hanging of the Fifth Chicago International Salon of Photography was greatly simplified this year because of the ingenuity of the print handling committee. Fred W. Edwards conceived and carried out the idea of building a miniature of the Charles B. Pike Rooms at the Chicago Historical Society, where the show was hung. Using wood,



cardboard, and craft paper, Edwards constructed a small model that was accurate in every detail, even to the colors of the walls and woodwork. (Each room can be lifted as a unit from the wooden base to facilitate "hanging" the tiny prints.) He then made up over 300 contact prints from the 35mm negative film used in producing the slide-film of the Fourth Chicago Salon last year. These prints were in correct scale for their miniature set, and the committee "hung" the tiny show to study arrangement of the pictures in the five rooms and corridor that comprise the Pike gallery. When the time came to hang the Fifth International, it became a simple matter to follow the miniature set, and thus the job of putting up the 299 prints in the show was accomplished in two evenings.

Flash Technic In Snake Photography

Sam C. Dunton*

ROUTINE photographic work at the New York Zoological Park resolves into various specific assignments involving publicity, commercial, portrait, copying, record, clinical, photomicrography, X-ray, and motion picture production. These assignments may apply to humans, animals, birds, reptiles, insects, fishes, parasites, etc.

In covering such assignments an appropriate proportion of the author's time has been engaged by the photography of snakes. Aside from occasional record shots of new specimens, the photographic section was recently called upon to make an entire series of snake pictures to illustrate a popular publication dealing with the identification of various North Eastern American species. I approached this project with some trepidation, not from fear of the subjects themselves, but because I had some slight knowledge of the difficulties of securing good photographic rendition with this type of material, without injuring the specimens themselves. There was very little in the literature to draw from as most photographers who had done similar work had in most instances written at some considerable length about the habits of their subjects, rather than furnishing an accurate report on the type of film, illuminant, lens or shutter speed used.

Various methods were tried, and different arrangements made, and the data reported herewith are the result of the author's experiments to date. It is hoped that it will afford other photographers faced with similar problems an approach to the subject, and perhaps lead to a standardized technic for obtaining good, accurate pictures of what is at the best, a challenge to any biological photographer's ability and ingenuity.

It is my belief that snakes can best be photographed under studio conditions where it is not necessary to depend on daylight for illumination. Strong daylight is an ideal source of illumination but its use limits the photographer to such time as it is available during the warmer months, and then to a relatively short period of each day.

* Staff Photographer, New York Zoological Park, Bronx Park, New York 60.
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One of the most important considerations in snake photography as in other animal work, is the choice of backgrounds. There is a great deal of diverse opinion as to whether, for purposes of identification, a snake should be photographed on a plain background or in a "natural" setting. One authority may feel that snakes may be most readily identified by the layman if the photograph is made on a plain background with shadowless light, while another equally eminent authority may feel that the snake should be presented in natural surroundings, as the average observer would see it. When receiving an assignment involving the photography of snakes for identification purposes, the feelings of the editor should be determined at the start, for it is most discouraging to produce a series of such pictures in natural settings only to learn that for this particular purpose, plain backgrounds are a must! However, when in doubt as to the natural habitat of the snake, the plain background should be used as it is very easy to introduce props such as branches, leaves, logs, and sand not usually found in the snake's native habitat. This point should also be observed when photographing snakes in the field—a Blacksnake, for instance, occasionally climbs, yet it is not generally found in trees. To photograph it hanging to a tree branch would convey the wrong impression to anyone viewing the picture.

As Mr. Arthur L. Smith of Cornell University pointed out in his admirable paper presented at the 1945 B.P.A. Convention in New York, a good zoological picture must be scientifically accurate, and unless great care is exercised at every step in the photography of snakes, error will creep in. Some photographers of zoological subjects, fishes, insects, and reptiles in particular, anesthetize their subjects in order to slow down their actions and permit longer exposures. The author abhors this practice, for scientific accuracy cannot be obtained by its use and the resulting picture is simply that of a specimen under a greater or lesser degree of anesthesia. At the New York Zoological Park a photographer would not be permitted to use such methods even if he desired to do so. Many snake pictures have been taken by "freezing" the subject, which simply means placing them in a refrigerator until they become so sluggish that they can be handled easily. This is perhaps a shade more ethical than drugging them, as a cold snake may move more normally, but even this borders on scientific inaccuracy as most snakes encountered out of doors are alive and active.

Furthermore in these days of flashbulbs and speed flash there is little, if any, excuse for anesthesizing or freezing specimens, particularly if a little care and ingenuity are used in arranging the subjects.

A snake picture, to be good enough to publish so that identifications may be made from it, must show the reptile alive and alert. The head and tail should be clearly visible and both in sharp focus. Snakes, even

when coiled, cover quite an extensive area and even with small apertures tend to get out of focus in some part. This is not too serious in the intermediate part of the body if the condition is not too evident, but the head and tail must be wire sharp. Lighting units should be so placed and controlled that the highlights are kept small to avoid obscuring important details in the characteristic markings from which identification may be made.

Snake pictures at the Zoological Park are generally made from a 45 degree camera angle, as it is from this angle that the average observer is apt to view a snake out of doors.

All snakes must be carefully handled, for even the non-venomous ones may inflict an annoying bite if squeezed or handled in such a way as to anger them. The venomous species should never be handled except by a person of considerable experience†, and even then every care and precaution should be exercised. Probably the safest way to photograph snakes is to put them in a small glass cage or aquarium that has previously been arranged with an appropriate setting. This case should be large enough so that the camera lens comes in quite close contact with it, or there will be some loss in definition, or the operator will find it difficult to place the front filler light because of reflections. The author prefers to work with the snakes in a setting arranged on a large flat top table. The camera generally used is a 4 x 5 Speed Graphic equipped with a 6½ inch Zeiss lens. Shorter length lenses cause undue distortion, while longer ones reduce the focal depth, which is a very important consideration when dealing with snakes. Focusing is done on a small object placed in the position the snake is to occupy, and in some instances when dealing with a snake that may be inclined to raise its head some distance, focusing is done on a point midway between the surface upon which the snake will rest and the point to which it is judged the head will come. When dealing with such specimens, and when photographing from a 45 degree angle, a camera equipped with a swing back would be very helpful in maintaining the maximum depth of field.

Lights are generally arranged as follows: One Press 40 flashbulb in a reflector at a 45 degree angle above and to the left of the camera, at a distance of five feet from the center of the set; one Press O flashbulb in reflector as near the camera axis as possible, and from 3 to 4 feet from the center of the set. Both of these reflectors are equipped with Victor Mellobeam spun glass diffusers. One Press O flashbulb is sometimes used in a reflector without diffuser above and to the rear of the set at

† The author wishes to express his appreciation to Mr. Brayton Eddy, Curator of Reptiles at the New York Zoological Park, as well as to Mr. Fred Taggart and Mr. Stephen Spencook, Keepers in the Reptile House, for their advice and assistance in the photography of various reptiles, some of which are used as illustrations in this paper.

Figure 1. Common Water Snake. A snake often mistaken for the Copperhead. In this particular instance, an accurate rendering of the shape of the head, tail, and clarity and contrast in the markings are of utmost importance. Photographed on ground glass, and illuminated from above and beneath.

Figure 2. Milk Snake. Arranged on a branch to show under markings, as well as the sides, back, head and tail. Flash bulb exposure, with 45 degree lighting and front filter light 1/200 second on Super XX film at f.22.

Figure 3. Cape Cobra. A venomous snake photographed in the setting shown below. Flashbulb illumination used with camera shutter at 1/200 second on Super XX cut film; 6½ inch lens stopped to f.22.

Figure 4. Studio setup used at New York Zoological Park snake photography. Snake in position for photographing is Cape Cobra. See text for description technic.

ure 5. On Guard. This mother
ttlesnake and youngsters were
otographed through the glass
their regular exhibition case.
cause of the glass it was im-
ssible to use a front filler
light to light the shadow
underneath the head.

Figure 6. Corn Snake. Photographed on ground glass, and illuminated from above and beneath. Flashbulb illumination used, as described in text.

Figure 7. Garter Snake. Although these snakes often arrange themselves on low branches of shrubs, it would have been better to show a definite ground line in the picture, thus indicating that it is normally a ground species.

igure 8. Pilot, or Mountain Black-
nake. Two flashbulbs in reflectors
quipped with diffusers used to high-
ight scales and simulate outdoor light-
ng.

a distance of from five to six feet. This provides a backlight when it is desired to afford a separation of planes when dealing with dark-colored snakes and with medium dark backgrounds. Super XX cut film is used and the bulbs are fired synchronously with a 1/200 second shutter speed. The film is developed in Ansco 17 (Borax) developer for 15-20 minutes at 65 F. Some snakes will hold a pose for a second or two, and with these it is possible to substitute photoflood lamps for the flash, a No. 2 photoflood replaces the Press 40 flash, and No. 1 photofloods the No. O flashes. With Super XX film the exposure required is 1/5 second at f. 16.

After the lights have been arranged, the camera set up and focused, and a suitable setting placed on the table, the snake is introduced into the set. Many of the non-venomous snakes can be tamed easily in a few days, and some of these can simply be placed in the right position and held for a few minutes with the hand covering the head and as much of the body as possible to prevent movement. When the hand is released they are quite apt to stay in position or may be shifted slightly if touched gently or approached with the end of a small stick. Once they have really started to move, however, it is necessary to catch them and proceed again as outlined above.

When photographing venomous snakes or with newly arrived specimens the author proceeds as follows. The snake is placed in a small wooden or metal box equipped with a sliding bottom, and a small observation port. The box is placed on the spot in the set previously determined and for which the camera is focused. The snake is observed through the port—being in relative darkness and restricted quarters it is quite likely to coil and lie dormant. If it not in the right position, it is gently pushed into the proper location by a stick inserted under the edge of the box, the bottom of which has been previously slid out, allowing the reptile to rest directly upon the material forming the bottom of the set. The box is then quickly removed, the snake raises its head to look about, and the picture is made. The assistant immediately replaces the box, and the same process is repeated if another exposure is desired.

When it is desired to photograph snakes on plain light backgrounds, lighting becomes more critical. Shadows that enhanced the picture in a habitat setting become unduly harsh when seen against a white background. The term "background" as used here is actually the surface upon which the snake is resting, the camera being set at such an angle that no other background appears in the field. Fair results may be obtained if the main light is used almost above the subject. This will cause a deep shadow along one portion of the snake, but this can almost be eliminated by judicious use of the filler light, used very low. Where it seems desirable to eliminate shadows entirely, a method suggested by

Mr. Clifford Pope of the Chicago Natural History Museum may be used. This method briefly is to place the snake on a large piece of ground glass or plain glass covered with tracing paper. This is illuminated from beneath with two photofloods and two more photofloods providing conventional "copying" light above. I had some difficulty with this arrangement as the photofloods beneath the glass seemed to excite the snakes and cause them to be very active. In addition, the glass became very warm, which no doubt contributed to their uneasiness. For this reason I substituted flashbulbs. Two Press O bulbs were used in reflectors equipped with diffusers at a 45 degree angle above and to one side of the glass and about four feet from its center.

The glass was placed on four supports about two feet above a white cardboard, and one No. O bulb was arranged at the center of the cardboard so that it was midway between the cardboard and the glass. This latter bulb was used without reflector and the side of the bulb towards the glass was covered with four thicknesses of Kleenex tissue. The three bulbs were fired synchronously with the camera shutter set at 1/200 second. The film used was Super XX. With this arrangement the light furnished by the bulb beneath the glass eliminated the shadows that were caused by the 45 degree lighting above. The 45 degree lighting naturally gave a better modeling than had the lights been used closer to the camera axis.

It might be well to note that sometimes an editor may ask for a picture that will show both the top and under markings of a snake. This can sometimes be effected if the snake is placed in position to be photographed, and approximately one-third of the body towards and including the tail turned over gently and held in position for a few moments. The entire snake must be covered by the hands. Sometimes the snake will hold this position for a few moments after the hands have been suddenly withdrawn. This will work only with certain specimens however, and certainly cannot be used with venomous species.

An alternate plan would be to place the snake on a piece of clear glass and make the picture from beneath. A white cardboard would have to be placed above the snake and illuminated separately to avoid shadows. A "from below" picture would be used in conjunction with the one made from above the subject.

The future availability of speed lamp equipment offers fascinating possibilities in snake photography, and the arrangements mentioned in this paper could be used with speed lamp units replacing the flash units. Recent developments indicate a reduction in the size of speed lamp reflectors which should make them very suitable for this type of work.

The production of really good snake pictures is a job that should not be done hurriedly; the arrangement of the setting, the positioning

of the lights, and finally the arrangement of the snake itself to get the most typical pose possible are items that should be done slowly and carefully. The statement of one well known advertising man, "plan pictures slowly, and shoot them fast" certainly applies to this particular field of zoological photography.

CONCLUSIONS

1. Snakes in general are most easily photographed under studio conditions.
2. The venomous species should be handled only by someone experienced in this procedure.
3. They may be photographed in glass cages, but it is preferable to work with them on a large table.
4. They should not be anestheized or chilled for photographic purposes, as an inaccurate picture will result, and the specimen may be injured or killed.
5. Care should be exercised in arranging habitat settings for the subjects, so that they may be presented in a background similar to the terrain upon which they are generally found.
6. Synchronized flash, carefully controlled, is the most desirable illuminant as it permits a fast shutter speed to stop ordinary movements.

Bulletin

OUR ANNUAL CONVENTION WILL MEET SEPTEMBER 5, 6, AND 7, 1946 AT THE LA SALLE HOTEL, CHICAGO, ILL.

Scientific Photography As An Aid To Observation*

H. Lou Gibson†

THE value of photography as a means for revealing and recording scientific facts is well known. Yet there is another important aspect to scientific photography that is only realized by those experienced in the field: Doing or supervising such work sharpens the powers of observation to a keen edge. Since there are many newcomers continually entering the field, it is worth while to outline how photography can become a double-bladed tool for those who are scientific photographers or for those scientists who work in harmonious cooperation with scientific photographers. First is the power photography has of revealing facts. Examples of the type of records are: spectrographs, solar photographs, highspeed photographs, time-lapse studies and radiographs. The second is the subject of this article.

There are three main ways in which photography can train observation. One, the subject must be studied closely if a revealing photograph is to result. Two, incidental experimentation often has to be done to control or prepare the specimen. And three, interest in the field is aroused to the extent of prompting research beyond the immediate needs of the problem. The effectiveness of these depends on the attitude of the photographer toward the undertaking. His mental outlook can well be one of alertness regarding the general significance of his subjects. In that way he can produce better scientific records and become a more valuable colleague for the scientist.

In substantiating these points, the author has to call on his own experience but makes no claims for the originality of the observations, with the likely exception of one. The main experience has been that critical observation did not really accompany a long-standing interest in nature until picture making necessitated it. The discoveries resulting often became as intriguing as the challenge presented by the photographic problems. The experienced photographer can readily supply his own examples to supplement the discussion.

Close Study

For an example of how this asset can result from photographic operations, we can consider the making of a good photographic de-

* Presented at the Meeting of the Biological Photographic Association, September 13, 1945, New York, N. Y.

† Medical Division, Eastman Kodak Company, Rochester, N. Y.

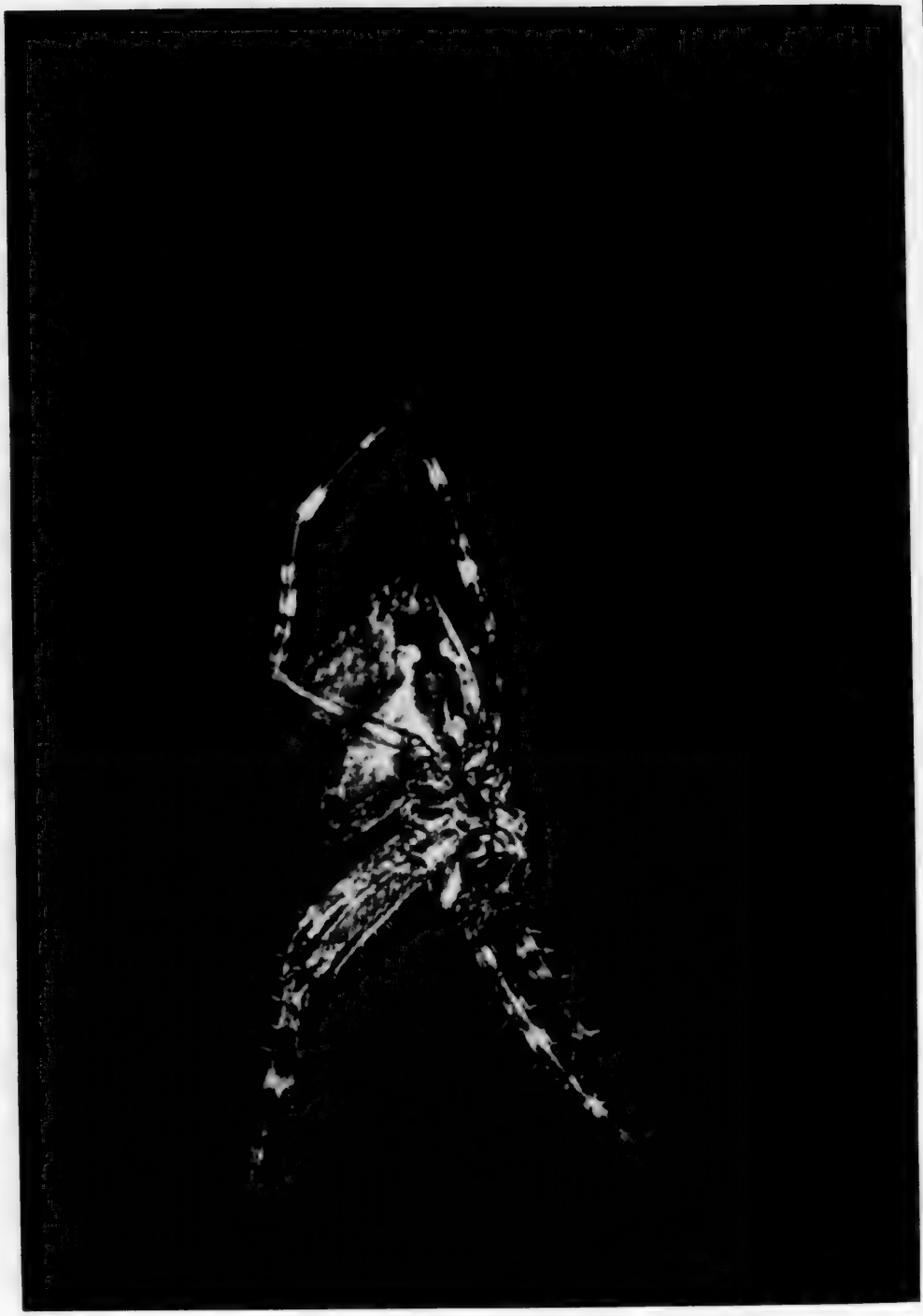

Figure 1. Garden Spider Hanging on Dragline. Made with Kodatron Speed-lamp, using night sky as black background.

scription of an insect. Merely pushing the specimen in front of the camera and touching the button is not the way to do it. The insect's texture and form must be studied to plan the correct lighting. If its legs are dark the fact will be noted because of the need for a light background behind them. The fact that its antennae point upward will be noticed because of the increased depth of field that is required. Fine detail will call for a technic involving maximum resolving power. Color characteristics may entail the use of special films and filters. Some of the keys may have to be furnished by photomicrography. Of course, these facts can be observed without the aid of photography. Nevertheless, making a picture is a means for emphasizing such detail and for helping to make sure that none is overlooked.

Studying the habits of the subject for a truthful rendition leads to discoveries too. Figure 1 demonstrates one of many little known facts about the common spider (Aranea sericata) which were observed as the result of a project to photograph the building of a web. The spider, when hanging at rest on the dragline, does not support its weight from its spinnerettes, as is generally supposed, but holds on to the thread with the hind feet.

Photography might also speed up discovery. For an example of this possibility we can consider the following. After many years of varied research, it has been recently determined that bats avoid obstacles in the dark by means of an acoustic "radar" system involving the echoes of supersonic cries emitted during flight. These are, of course, inaudible to human ears. In making figure 2, it was noticed that the animal opened its mouth (to start the cries) each time it began to fly. This was an important observation photographically because it gave a clue as to when the shutter should be released. Scientifically it meant nothing to the author, because the reason was not then known nor being investigated. However, had an early researcher taken the picture and thus been led to the observation, the direction-finding mechanism might have been discovered sooner.

Incidental Research

The scientific photographer is constantly looking for means to prevent his living subjects from hopping, flying, crawling, swimming, or wilting out of the field of view. And even the preparation of dead specimens often involves much investigation.

To help in these problems, the results of research in non-photographic fields usually have to be called upon. For example, standard drugs are used to quiet living specimens for photography and various well-known solutions are used to clear gross specimens. Thus it is hard to evaluate the worth of this aspect of photography; especially since

Figure 2. Brown Bat. Synchroflash with Graflex at 1/1000 second. The animal had just "taken off" from screen window, which was beyond depth-of-field of lens. Blue sky was background, but it recorded black because of short exposure.

the investigations rarely go beyond the expedients of the moment. In spite of this though, the work that has to be done is valuable training in applying the scientific approach, and as such alone trains the powers of observation.

In the author's experience are experiments with urethane and chlorotone for slowing down the cruising speed of fish. It has also been found that a mixture of ether and alcohol is better for quelling insects rather than ether alone. The recovery from ether is too sudden; whereas the mixture leaves the specimen with a certain degree of stupor after the relaxed stage of recovery has been reached.

This aspect of scientific photography ought not be dismissed, however, as not being a likely incentive toward discovery. For an example:

Figure 3. Fireflies (Photinus consanguineas) Showing Death Glow. Double exposure with Kodak Precision Enlarger. Left, female; right, male.

Fireflies in a moribund condition, figure 3, emit their so-called death glow. By the time the insects are positioned, however, the brightness of the light organs becomes insufficient to make color photography of the phenomenon successful. Even for black-and-white pictures, recording the glow has to be done at full aperture after the general exposure for the insect has been given. To do this for color photography requires a secondary exposure so long that movement occurs. What is needed is a means for intensifying the glow.

Were a well equipped entomologist faced with this problem, and determined to get the picture, he might find a means, such as relaxing the insect's air tubes, for accomplishing this. In doing so, it is likely that he would uncover new data on what is still somewhat of a scientific mystery — how does the firefly do it? The author attempted to intensify the glow with ultraviolet radiation. But the light organs were not fluorescent. It was found though that the body juices of the insect fluoresced blue, and this fact is generally realized by entomologists.

Widening Interest

The photographer who takes a few pictures of wild flowers and then becomes so interested in the field that he is spurred to intensive study is well known. The same thing happens to

Figure 4. Angel Fish Tilting into Light Beam. Open-flash (SM lamps) with Graflex. Angel fish at top was in beam from flashlight and had lined itself up with the ray. Goldfish at bottom was not in beam and hence not influenced. Dotted line shows direction of ray.

make ornithologists out of bird photographers. These are major examples of the change in outlook that doing scientific photography can bring. Less spectacular, yet valuable too, are the smaller leads often suggested and followed up because of observations made during photographic projects. Most scientific photographers have experienced such diversions. The author will be content with exemplifying the point with one of his own that led to a discovery, which as far as he can find, has not been previously reported.

While experimenting with lighting angles for photographing small tropical fish, it was noted that the fish oriented themselves dorsad toward the light, figure 4. By changing the angle of illumination it was possible to tilt the fish until some of them were actually swimming upside down. This suggested a means for testing their color perception.

A focusing flashlight was obtained and covered with Wratten C5 (Blue), B (Green), A (Red), and No. 87 (Infrared) filters in turn. It was discovered that the fish reacted to, and hence could see, blue, green and red but not infrared. (The latter point was detected by subjecting the fish to infrared radiation in the dark and then turning on the white light suddenly.)

Another promising fact is that when two lights of unequal intensity are used, the fish react to the stronger one. This suggests a feasible method, for those appropriately equipped, whereby quantitative determinations of color perception might be made by measuring the intensity of monochromatic sources required to offset a constant white light.

To summarize the points of this article, a paraphrase can be made of the slogan of the Chicago Section, Nature Division, Photographic Society of America. The result is: To make better scientists of photographers and better photographers of scientists. This is not too far from the aims of the Biological Photographic Association!

"Stan"

As your new president I feel both honored and concerned at being chosen to guide the destinies of an organization comprised of members who are active in so many different fields of biological photography.

This association is your association. If you have a suggestion, or a criticism, make yourself vocal, or literary, about it. Each will merit consideration.

Your association is an ever growing one, in membership, and stature, concerning itself with a greater number of activities affecting biological photography. Fellowships (approved and soon to become a reality), training of biological photographers, budgets for departments, and placement efforts, are some of these activities. The spirit of cooperation among officers and directors is a good augury for continued growth. May I call your attention to the listing of officers, directors and committee chairmen published elsewhere in this issue.

Plans are being made now for next year's convention, and with war time restrictions behind us, we should have an outstanding one. There will be more on this in later issues of the Journal. I should like to see the Salon built up, and to that end, I can assure you that your prints will be hung under favorable conditions, on association easels; the official family is committed to this. So start now laying aside material for the Salon.

Cordially,

STAN MCCOMB

Salient facts about Stanley J. McComb, nicknamed Stan, or Mac. Born in 1905 in St. Paul, Minnesota. Messed with photography in high school and college and having acquired a B.A. engaged in commercial photography in St. Paul. To date eighteen years in photography, eleven of them in clinical photography at the Mayo Clinic, where, behind a variety of cameras, the entire gamut of clinical photography is covered under diverse conditions and situations. Married, with two children, who provide the only extra curricular photographic activity.

Twelfth Report of the Committee on Motion Pictures, 1945

I. *Films reported by our members.*

Lester V. Bergman : Gonadogen 1600′, Co, So, An; Adrenal cortex, 1600′, Co, So, An; Vitamin B Complex, 1600′, Co, So, An; Pertussis, 1000′, Co, So An; Growth and desent of testis, 800′ Co, An; A typical thyroidectomy, 400′, Co; Anastomosis, 400′, Co; A typical rhinoplasty, 1700′, Co, An; Repair of peripheral nerve injuries, 450′, Co; Amebiasis; Median episiotomy, 400′, Co; Plastic repair of orbital defect, 400′, Co; Proposed supply route for U.S. Army, An. All 16mm.

Joseph S. Devitt: Gastroscopy — endoscopic examination of the human stomach, 400′, Co, 16mm.

Allen Hancock: Diagnostic techniques in neurosurgery, 400′, Co, Si, 16mm.

Mervin W. LaRue: Hematology-physiology of hemaporitic principles, Co, Si; Managing fresh wounds of violence, Co, Si.

Charles Lindsay: Subdural hematoma, 400′; Partial resection of the stomach, 400′; Extradural hemorrhage, 400′; The cranial cavity (Brain dissection) 400′; Ventriculography, 400′; Photography by John A. Maurer. All Si, Co, 16mm.

Robert D. Little: Plastic repair of burns, 400′; Plastic repair of nose, 400′; Repair ruptured cervical disc, 400′; Cyclodiathermy punctures for the relief of chronic simple glaucoma, 200′; Removal of cataract, 150′, all Co, 16mm.

Lorus J. Milne: The burying beetles—Technical account of behavior of genus Microphorus (Silphidae) 500′, Co, Si, 16mm.

Dr. Irving Rehman: In preparation: X-ray motion picture of the dynamics and kinematics of the human gait and controlled muscle reëducation.

Julius Weber: Cinephotographs of living striated muscle; Incident light and color cinephotomicrographs of trypanosomes and leichmania.

C = color, Si = silent, An = animation, So = sound.

II. *Catalogs.*

How and where to obtain Motion Pictures of the U. S. Dept. of Agriculture. 1945. 8 pp. folder listing supply depots for their films.

Indiana Univ. Extension Division Bulletin, Visual Aids catalog. 31(1):1-62.

Society of American Bacteriologists, Dr. H. E. Morton, Univ. of Pennsylvania, Philadelphia 4, Pa. 124 films listed.

III. *Publications of interest.*

The film in science. *Nature. 156*:426-427 (1945). A brief report of the conference at Technical College, Huddersfield on Aug. 21-Sept. 2.

A catalog of medical films in Great Britain is being prepared by the Royal Society of Medicine, 1 Wimpole St., London W1, according to the November 29th issue of *Nature.*

See and Hear. E. M. Hale & Co., Eau Claire, Wis. A new journal on audio-visual learning aimed for the elementary schools.

The handling, repair and storage of 16mm films. Eastman Kodak Co., 1945. 8 pp.

Nichtenhauser, A. Health film production. *Film News.* N.Y., Feb. 1945, 1 p.

———————— A program on health medical films. 1944. 19 pp. Mimeogr.

H. E. Morton,
Oscar W. Richards, Chairman,
Box A, Buffalo 15, N.Y.

Moody Produces New Movie

Vivid full-color scenes from astronomy and natural science with a religious approach are featured in "The God of Creation," sound motion picture recently produced in the West Coast laboratories of Moody Bible Institute, Chicago, by Irwin A. Moon.

In the opening scenes of the picture the audience takes a trip to the stars by means of photographs taken through the giant 100-inch telescope of Mt. Wilson's Observatory in southern California, and also views of complex gyrations of our own solar system.

Lapse-time photography is utilized to demonstrate the beauties of natural science. The illusion of flower buds developing into full-blown blossoms in a few seconds is created through this time-compressing photo technic. The metamorphosis of a caterpillar is traced from its role of garden marauder until it emerges as a multi-hued air-borne beauty.

The mysterious manufacturing process of photosynthesis is also shown as it takes place in a green leaf, as well as the pollination of flowers. The photosynthesis picture is believed to be the first of its kind.

Photomicrography is also employed in the film, as the audience peers into the microscopic world and observes the antics of tiny paremecia, enlarged more than a million times.

In addition to its religious emphasis, the producers believe that the new picture will be valuable as an educational film. Some of the photo technics employed are so intricate that they are not readily obtainable in ordinary visual education reels, and it is planned to make "The God of Creation" available for schools and colleges, as well as churches.

American Standards Association Notes

Erratum. In the December, 1945 issue of the Journal, page 76, line 2, the standards designation of the test plate was given as Z38.1.16. This should read Z38.7.16.

Since this standard was published a new firm has taken over the production of the test plates—Buckbee Mears Company, Lindeke Building, St. Paul 1, Minnesota. At a meeting of Z38 on December 14, 1945, Dr. Oscar Richards exhibited a sample test plate made by the above firm. The price is from $16.00-$20.00, depending upon the number of orders received. While expensive, the plate is well made, and should be useful to those who need to test 2 x 2 inch projection lenses.

Photographic Processing of Paper. On January 1, 1946 the ASA published for trial and criticism "Photographic Processing Manipulation of Paper," Z38.8.6———(price—30 cents). This standard gives specific directions under the following heads: darkroom tray processing; processing by mechanical manipulation; processing manipulation and requirements for fixing, washing, and drying; straightening prints. Under darkroom tray processing, procedures are given for both single and several prints (up to six).

This standard should prove useful in training new darkroom workers, as the directions are specific and easy for the novice to understand.

LOUIS PAUL FLORY
Yonkers, N.Y.
BPA Representative

ERRATA

ERRATA in Milne "Coated Lenses for Biological Photography" — J. B. P. A. 14 (2):58-75 (Dec. 1945).

p. 62 footnote, lines 2 to 4 should read: "is proportional to the ratio of $\frac{n_f - n_a}{n_f + n_a}$. That from the film-glass surface is given by the ratio $\frac{n_g - n_f}{n_g + n_f}$. For equal reflection from these two surfaces, the two ratios must be equal, i.e. $(n_f)^2 = n_a \cdot n_g$. But $n_a = 1.00$. Hence for the ideal case of equal reflection, n_f must equal $\sqrt{n_g}$. Although approximate, these values are close enough for practical use."

p. 63 for "$n_D = 1.517$" read "$n_D = 1.570$".

p. 64 footnote, line 2 should read: "about 5.4×10^{-9} inches".

p. 70 footnote: for *"Hydrosychidae"* read *"Hydropsychidae"*.

p. 73 last line: delete "length".

CURRENT PHOTOGRAPHIC ABSTRACTS

Production of Scientific Films for Biological and Medical Purposes (on 16-MM. Film Stock). J. Y. Bogue. *Phot. J.*, **85B**: 27-31, No. 2, March-April 1945. The special considerations which arise in producing medical and biological films are discussed: (a) those concerned with the lucid presentation of old knowledge, and (b) those concerned with the demonstration of new knowledge or technique. The factors to be considered in preparing the script are discussed in detail, and the author considers the desirability or otherwise, in general cases, of using sound film, animation, superimposed outlines, and dissolves and other trick methods. The special technique necessary in laboratories or operating theaters is reviewed, and recommendations are made for the types of lens suitable and the type of lighting required where the heating factor is important, as in biological subjects. The preparation of a card index of the film reel is suggested, and in all cases the assistance of a professional film unit should be sought and the film checked by experts in the subject before release, especially if it is to be exported. (Author's Abstract)

Medical Films. *Brit. Medical J.*, p. 156, No. 4360, July 29, 1944. Recently the Scientific Film Association (in England) set up a committee, under the chairmanship of Dr. S. J. Reynolds, to further the production and distribution of medical films suitable for circulation within the medical profession. After the war it is hoped to set up a central film library. **Seeing Is Believing.** W. M. Eccles and S. J. Reynolds. *Ibid.*, p. 323, No. 4365, Sept. 2, 1944. The aims and objectives of the recently formed committee of the Scientific Film Association are stated. A questionnaire is being circulated to aid in the collection and cataloguing of a central film library. **Seeing Is Believing.** *Ibid.*, pp. 281-82, No. 4364, Aug. 26, 1944. In a critical appraisal of four Imperial Chemical Industries Limited films on anesthesia, it is urged that greater use should be made of films, both to supplement existing teaching techniques and to counteract the slavish following of textbook dogma prevalent among students. F.G.

Some Considerations in the Masking of Color Transparencies. R. D. Reed. *Brit. J. Phot.*, **92**:26, Jan. 19, 1945. The author points out that, after a color transparency has been masked to reduce the density range, it is possible to increase the gamma of the separation negatives, thereby obtaining improved color separation. He suggests making a negative mask on panchromatic material and developing to a gamma of 0.4 to 0.5. The tungsten light used for printing is unfiltered since the use of a blue filter results in overcorrection. The effect of the mask is to increase the brightness of the blues and reduce that of the reds. F. P. G.

Simpler Film Filing. [C. M. Effinger.] *Science News Letter*, **47**:359, No. 23, June 9, 1945. A loose-leaf cataloguing procedure is described for filing individual frames of motion-picture film which is said to be simpler than the card-index system. Each loose-leaf page is divided into seven sections, and in each section is cut a hole the shape and size of one frame of film. At the top of each page

is an itemized summary of all the frames on that page and similar scenes are included on any given page, e.g., streets, trains, boats. Each item is keyed to a particular film so that any desired sequence can quickly be located, thereby avoiding the necessity of running through hundreds of feet of film. A photograph of the catalogue is included. K. G.

Three Practical Photoflash Tables. N. M. Eames. *Commercial Photographer*, 20: 210-11, No. 7, April, 1945. The three Photoflash lamp tables reproduced in the article were worked out originally for use in the U. S. Navy. They give: (1) a condensed "guide-number" table for all makes of lamps when used with black-and-white and color films indoors; (2) a lamp-to-subject table for all "B" Photoflash lamps and all color films, based on meter readings, for use in daylight or sunlight; and (3) a similar table for black-and-white films for outdoor work. T. H. J.

Book Reviews

NEW YORK by Andreas Feininger. Introduction by John Erskine. Ziff-Davis Publishing Company, Chicago, Illinois. 108 pages, 11 x 15. Ninety-six photographs. Cloth bound. Maps inside both covers, one showing camera locations. $5.00.

Undoubtedly a vivid picture story of our country's "Greatest City." A book that makes one want to see this show place, and makes this Midwesterner glad that he does not have to live there. But, as Mr. Erskine observes in his introduction—one does not go to New York for a rest or relaxation. All of the pictures are good, and some taken with a telephoto lens are startling. Mr. Feininger chose these 96 from more than a thousand negatives. He made an excellent selection. These pictures show the various, and frequently extremely contrasted aspects of the city. It is all here—grandeur and misery—panorama and closeups—by day, dusk and night. Gay and tragic situations depicted among the many kinds of people in this melting pot. There are many thrills for you between the covers of "New York."

Ray Miess

RECORD PHOTOGRAPHY IN INDUSTRY by Wallace L. Cornwell. Buffalo, N.Y. One of a series of vocational and professional monographs published by Bellman Publishing Company, 6 Park St., Boston 8, Mass. 23 pages. Paper covers. 75c.

This is a timely vocational guide covering types of photographic record equipment, vocational opportunities, qualifications, remunerations, advancement opportunities, vocational training, etc., in this interesting, rapidly expanding field. Mr. Cornwell evidently has made a serious study of his subject, not even missing the listing of the disadvantages of the vocation. We hope that the returning veteran, among others will give this field due consideration. This book will certainly help him.

Ray Miess

Association News

A letter dated September 12, 1945 from Dr. H. M. Dekking, of Nymegen, Holland, reached the Secretary in October, the first news to reach us in many months. He wrote:

> "Many thanks for your kind letter of August 8, which I received today; it is a fine feeling to get some contact again with the outer world after five years of isolation. We yere living quite near the famous Nymegen bridge for which your admirable parachute troops have been fighting so hard; our house was burned down by the retreating Germans and my clinic was badly damaged by shell-fire, but we lived through it and it was most exciting."

Dr. Dekking's interest in photography as applied to ophthalmology has continued unabated. During the occupation, when active photography was impossible, he wrote a treatise on the subject of optics, of which he has an extensive knowledge. We will hope to hear more about the results of this work in the future, as Dr. Dekking has promised to supply our files with some of the material written during this period.

We have not heard directly from our member Dr. Sylvester Prat, of Prague, Czechosolovakia, but a welcome letter has come from the Office of War Information with the news that Dr. Prat is well and has returned to his work at the University.

Lloyd Varden is now in New York City as Technical Director of the Pavelle Color Laboratories, 533 West 57th Street. An account of the Color Laboratory appeared in this Journal in December 1945, Vol. 14, No. 2.

Leonard Perskie has opened the Graphic Studios at 231 Tenth Avenue, New York 11, N.Y. The studios are prepared to take orders for original photography in black and white, or natural color; carbro or relief prints; murals, giant photos; enlargements; transparencies; air brush coloring; composites; half-tone screen prints or negatives; facsimiles.

The news about our members in the Medical Museum and Arts Detachment at this time (Jan. 1945) is: Captain Eddy is in the United States and when last heard from was in Muncie, Indiana "learning to be a civilian again." Fred Beal and Peder Lund are home and discharged from the Army. Howard Francis is en route home from France. Paul Showstack is a civilian, working in Boston for the Beth Israel Hospital. Melvin Shafer is a civilian, working in the Photographic and Medical Arts Service of the Army Medical Museum. Captain Taylor has been discharged and is back at Temple University. Al Levin is still on Saipan, photographing at a Station Hospital. Sydney Shapiro

is a civilian and is back in New York. Captain Brownell, when last heard from, has been switched to the Atomic Bomb Investigating Commission and had left Saipan for Japan.

Instruction in Medical Photography

In the past few months the Secretary has received an increasing number of requests for information about courses in medical photography. Although items about some of the available courses have appeared in our Journal before, it may be useful to summarize the information at this time for the benefit of readers who may be receiving similar inquiries.

Courses in Photography

The Rochester General Hospital, Rochester, N.Y. A course in medical photography is given for a minimum of one year. Experiments are still being conducted to determine the proper prerequisites, but for the present the applicant must be at least a high-school graduate. Much of the instruction is on an apprentice basis. However instruction is also given on the theory of photography; and classroom work in anatomy and physiology, medical terminology and pathology is required. Instruction in photomicrography is included.

Tuition for the course is $50.00. Further information may be obtained from Milton G. Bohrod, M.D., Director of Laboratories.

Rochester Institute of Technology, Rochester, N.Y. This Institute (formerly the Rochester Athenaeum and Mechanics Institute) gives no courses in medical or biological photography as such. However it gives a first-year course covering fundamentals valuable to a serious student of photography in any field; and in the second year offers a varied curriculum with a number of elective courses. By a wise choice of these electives, of which photomicrography is one, the student can compile a course which will be directly useful to him, in biological photography.

Applicants are required to furnish certification of high-school graduation, college training or other personal qualifications indicative of ability to profit by the instruction at the institute. Those without professional or technical experience should be high-school graduates and have the recommendation of their high-school principal. Credits in intermediate algebra, geometry, physics and chemistry are desirable. The Institute gives classification examinations which include mathematics, reading, mental alertness, and a physical examination.

Tuition and fee charges amount to $286 a year, payable in two installments. Further details may be obtained from Mr. G. B. Neblette, Supervisor, Department of Photographic Technology.

Some biological photographers or departments of biological photography take students or apprentices by individual arrangement, from time to time. This is usually on an informal basis. The student receives little planned instruction, but does get practical experience in the technic used by the particular department. In departments where a wide range of work is covered, this experience may amount to a thorough grounding in the practical aspects of biological photography. How much of the basic principles and theories of photography are absorbed at the same time usually depends on the student's own initiative.

Besides the sources of instruction discussed this far, there are of course Schools of Photography throughout the country. Much valuable teaching can be obtained from them, but as they are planned primarily for the commercial or news photographer rather than the scientific photographer they are not listed here.

Combined Courses in Medical Art & Photography

The other photographic courses listed in our files are not for the photographer as such. They are for the medical artist who implements his work with photography, or the medical illustrator whose study is the entire field of visual education as applied to science. Those that we have on record are listed here, in alphabetical order:

Johns Hopkins University, School of Medicine, Baltimore, Md. The courses for art students are divided into two groups, those for medical illustrators who wish to take advanced work, and those for beginners. The advanced courses are special courses to fit the needs of workers who may wish to specialize in drawing, photography or moulage. The minimum fee is $25.

For beginners a regular three-year course is given. Applicants must have studied the premedical sciences and be graduates of an art school. The fee is $100. The course includes anatomy, microscopic observation, medical art, photography (including photomicrography and cinematography) and moulage.

The course for medical students and faculty members includes drawing, photography and moulage for one afternoon a week throughout the year.

Massachusetts General Hospital, Boston, Mass. A Medical Illustration Course is given by Miss Muriel McLatchie. We have no information about the curriculum except that it includes two months training in a medical photographic laboratory. Further details may be obtained from Miss McLatchie.

Southwestern Medical College, Dallas, Texas. This institution, working in conjunction with Southern Methodist University, has inaugurated

for the first time a definite curriculum whereby students may gain their Batchelor of Arts Degree, majoring in Medical Art, by doing three years work at Southern Methodist University and two years at Southwestern Medical College. Thus the prerequisite for the student in Medical Art is a three year pre-medical course, including Art, at Southern Methodist University, or similar hours of credits from other colleges of Arts and Sciences. He must have a general average of C Plus or better in his premedical work, with grades in Art Courses averaging B or better. At the Medical College he takes the regular medical courses which have the most bearing on medical art, as well as drawing technics, photography and photomicrography, and the preparation of exhibits, including moulage. Graduate work in the Department of Medical Art will enable the student to receive the Master of Arts Degree in Medical Illustration from the Southwestern Medical Foundation.

The tuition is $600 per academic year. Further details may be obtained from Prof. Lewis Waters, Chairman of the Department of Medical Art and Visual Education.

It will be seen from the above that medical artists are better supplied with formal instruction in their own field than are biological photographers. This is natural, as the artist's work is not that of recording but of actually re-creating a medical subject. More knowledge of anatomy and of specialized artistic technics is a necessity. However so many new possibilities are opening up for biological photography, by means of specialized methods and equipment, that the photographer too feels the need of instruction especially planned to fit him for the biological field. We are glad to note that the Institute for Visual Education, to be opened by the Medical School of the University of Illinois, will give courses specifically planned for the photographer as well as the medical artist.

MEETINGS

The Association of Medical Illustrators will meet in Philadelphia in June, 1946.

The Association for Scientific Photography met in Alliance Hall, Westminster, London, on October 26, 1945. C. W. Bradley, A.I.P.B., F.R.P.S. read a paper on "The Organization of an Industrial Photographic Unit." A copy of this paper is in the BPA files. On November 29 the Association met again to hear a paper on "Light Waves and Lenses," given by H. H. Hopkins, B.Sc., Ph.D., F. Inst. P. The Medical Group met at Hastings Hall, Tavistock Sq., London to discuss: "Equipment for Medical Photography," at their fall meeting.

The Chicago Chapter of the B.P.A. Lt. Col. Tibor Benedek is back in Chicago after service on Okinawa, and was invited to be guest at a

dinner to take place before the Chapter meeting of December 14. Much to the surprise and pleasure of the Chicago members, Major Ralph Creer dropped in at the last moment too. Other guests were Harris Tuttle of the Eastman Kodak Co., and L. E. Weber of the Eastman Kodak Stores, Chicago. Miss Avis Gregersen writes: "It was a wonderful get-together. Everyone seemed to enjoy themselves and all of us were so glad to see our returning servicemen. At 8 p.m. we left the table and went to the second floor of the EK Stores Building. Mr. Tuttle talked to our organization in a round-table discussion of color-problems for the medical photographer. He was, as usual, in good fettle, and everyone thoroughly enjoyed him and profited thereby. We all learned something of interest in our work."

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Some individuals who have a deep interest in the advance of scientific photography help finance a wider range of activities for the Association by becoming Sustaining Members.

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Veterans Seek Apprenticeships

Increasing demands are arriving at the Office of the Secretary for placement of veterans who wish to serve apprenticeships in departments of biological photography.

If you can assist this project in any way please forward information to

MISS ANNE SHIRAS
University Office
Magee Hospital
Pittsburgh 13, Pa.

THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

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JUNE, 1946

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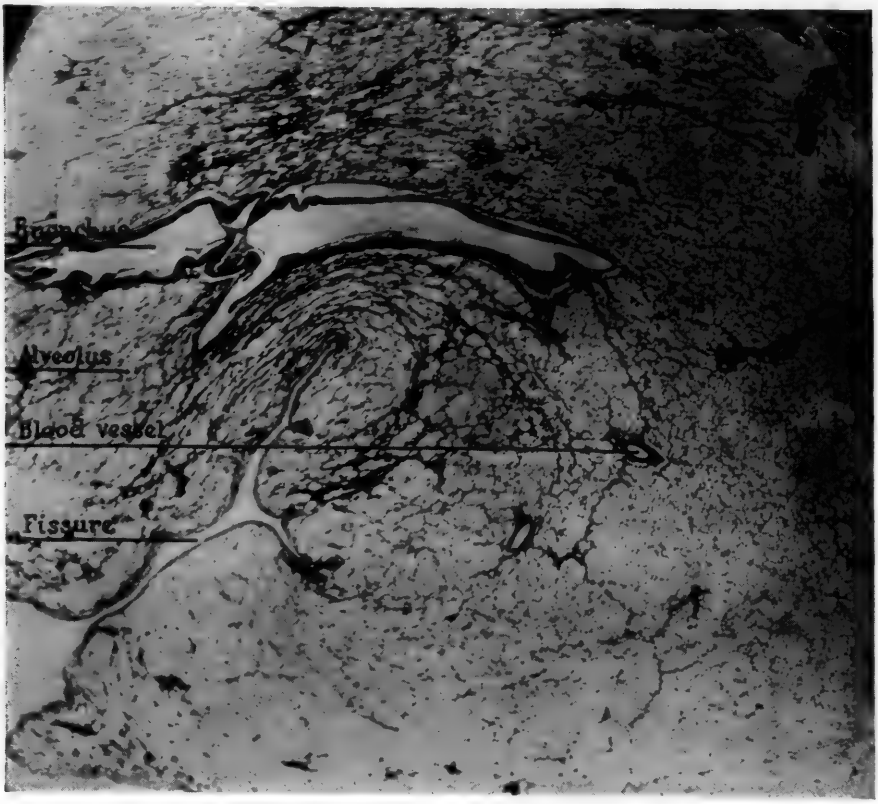
Alveolus
Blood vessel
Fissure

Fornix
Thalamus
Red nucleus

A New Method of Photographing Microscope Slides

Steve Greenberg*

THERE is on the market today much expensive and elaborate apparatus for photomicrography. The proper use of this equipment entails equally elaborate methods which only skilled people can satisfactorily execute. In general, all microphotographic methods in use at the present time have some things in common, particularly the fact that all of them use at some stage a microscope, or some system of lenses arranged in a microscopic fashion. Also, they use approximately the same type of focusing mechanism, illumination, and some type of camera.

We have developed a simple technic by which any person with a small knowledge of photographic principles should be able to prepare photographs up to 30 × magnification from stained tissues on slides, without the use of expensive equipment or any involved processes. The only materials required are a reasonably good photographic enlarger with approximately an f. 4.5 lens, sheet film of a convenient size, and contact printing paper. These materials are supplemented of course, by the regular darkroom equipment such as developing and fixing solutions, printing frames, dryers, etc. The technic is as follows:

1. The tissues selected for use should be stained with Heidenhain's iron hematoxylin and differentiated carefully to demonstrate nuclei. Since this stain is black it is well suited to photography. The Pal Weigert method for nerves is excellent for photographing slides of this tissue. Other stains can also be used but careful differentiation is extremely important.
2. The selected slide with tissue on it is placed in the negative carrier of an enlarger in the same manner as a regular negative and enlarged to any desired size.
3. The enlarger is focused in the conventional manner.
4. The exposure is made on sheet film for about ¾ of a second at f. 4.5 under normal lighting conditions, the time exposure being in proportion to the density of the tissue. The sheet film merely reverses the black and white tones so that the finished picture will correspond exactly to the tissue being photographed, and not appear as a negative, figures 1 and 2. The process with suitable modification can be adapted to color film as well.

* Creighton University School of Medicine, Omaha, Nebraska. Received for publication April 4, 1946.

LEGEND FOR FRONTISPIECE

Top. Section of Lung. Heidenhain's Iron Hematoxylin.
Bottom. Cross Section of Midbrain. Weigert's Myelin Stain.

5. The sheet film is developed and fixed in the conventional way and allowed to dry.
6. The image on the sheet film is then printed by the contact method on photographic paper.
7. The film may then be filed away and used as often as needed without ever using the original slide again.

As stated above, the method outlined above does not entail the complicated equipment and methods of conventional photomicrography but is an extremely simple way of obtaining good pictures. When compared with other existing methods direct slide enlarging presents several advantages. First, extreme enlargements can be made by this technic without the interference of grain or other defects of panchromatic film. In the other methods grain present on the panchromatic film greatly hampers the enlarging which is thus limited to the enlarging power of the microscope itself. Secondly, direct slide enlarging is very inexpensive. Four dozen 3 x 4 inch pictures can be made for about $5. Also, as has been said before it is a very simple method and may be easily mastered by any person. Lastly, it is a speedy method to obtain slide photos, since focusing, exposing and printing are combined more or less into one simple fact step. With the use of inexpensive infrared lamps for drying, the time can be cut even shorter. It is possible by this method to prepare a completely finished picture in about ten minutes, in contrast to the ordinary methods involving focusing, exposing, and more extensive processing of the film.

There are some other uses of this technic to which we would like to call attention. If it is employed in a course of Histology to prepare labeled photographs directly from the slides which the student is using, much of the instructor's and the student's time will be saved as the student will be able, by using these labeled photographs, to become acquainted with the general plan of the tissues very quickly and can then begin the study of the cytology. We feel that a knowledge of the gross structure of a tissue is prerequisite to the study of the cells that make it up.

This method may also be used to advantage in giving laboratory demonstrations in embryology, since sections of embryonic material may be greatly enlarged and displayed serially. Also sections of embryos at different stages of development may be photographed individually and the pictures mounted so as to give a progressive view of development. This method may also be used to furnish inexpensive illustrations for written articles or theses, and also as a method for giving laboratory examinations.

To sum up, we think that the direct slide enlarging method has a number of advantages which should make its use worth while in the easy and inexpensive preparation of illustrative material for classes, or for some types of publication.

Method for Observing Surface Structure

Max Bachrach*

PRIMARILY, this method was devised for the purpose of examining and identifying the cuticular scale structure on the outside of mammalian hairs; in our laboratories such examinations are required daily for the determination of the various types of fur peltries. Fur peltries, through bleaching and dyeing operations, undergo a certain amount of appearance changes. These peltries are not always clearly determinable by microscopical examination, but by using the method outlined in this article we have eliminated our previous difficulties. Our experience leads us to believe that its use can be extended to many other fields where the surfaces of various substances require microscopical examination and study.

In our laboratories we are confronted with varying problems requiring identical methods of identification. It is necessary to distinguish between different species of animal peltries as well as to note the differences in seasonal growths and changes in these hair coverings. Damage done to these hair fibers by insects, bacteria, or mold growths, is often a clue to the proper treatment of these peltries in the processing plants.

This method has proven very interesting also in the detection of crime where only a few hairs have remained as clues.

Present-day court procedure requires visual or documentary evidence to prove the opinions of experts, and photomicrographs such as those presented in this article, have proven far more emphatic than oral descriptions. Assertions are sometimes made in the contest of patent rights where process patents make claims of certain advantages obtained through the change of the surface structure of materials, and visual evidence is an important form of testimony to substantiate or disprove such claims.

The methods previously used for depicting the surface of animal hairs was originally by the use of the camera lucida, but this procedure too often permits inaccuracies on the part of the technician. The next method used was the mounting of hairs in a medium of higher refractive index than that of the specimen, and then photographing. This also proved unsatisfactory for two reasons: 1. The refractive index varied with the amount of light absorbed by the specimen and different mediums were required for accurate results; 2. If the pigmentation was too concentrated and dense, or the color too deep, no well-defined picture

* Fur consultant. 370 Seventh Avenue, New York. Received for publication April 15, 1946.

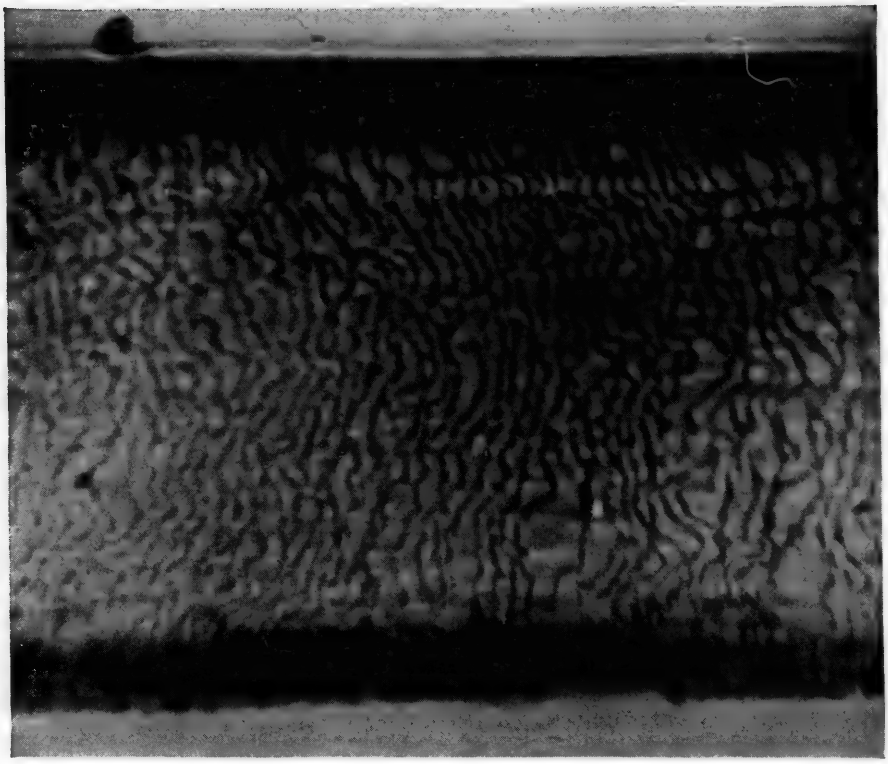

Figure 1

Figure 2

Figure 1 and Figure 2. Badger hair used in shaving brushes. Figure 1 is a healthy sample, whereas Figure 2 has been damaged by moths. After the hair is cleaned, such information cannot be obtained macroscopically, but can be discovered by the use of the microscope. The pigment of the Badger hair is too dense to permit observation of the cuticular scales by any other method than that given in this article.

OPPOSITE PAGE

Figure 3. The Rabbit has a different construction of guard hair from that of other mammals in that in its cross section it is shaped like a dumbbell, that is, the center of the hair shaft is thin and the edges bulge out. This photomicrograph shows this fact quite clearly because of the shadows of the rounded dumbbell edges.

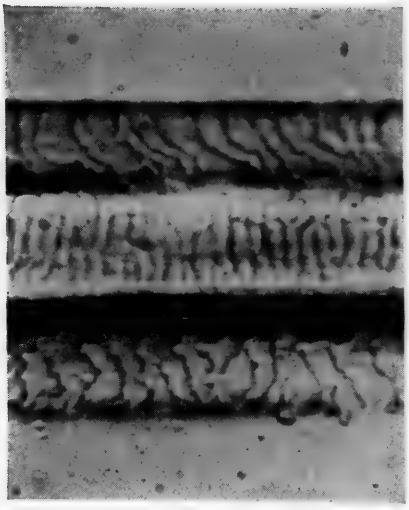

Figure 3

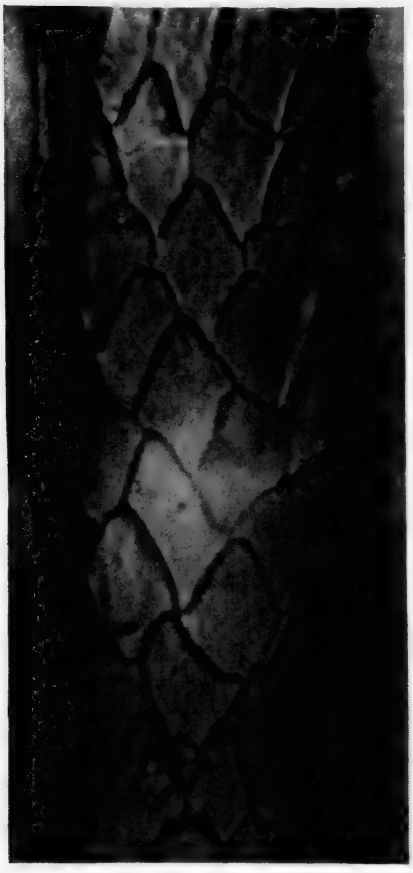

Figure 4

Figure 5

Figure 4 and Figure 5. Two species of Grey Fox—No. 5 is the North American type, and No. 4, the South American type. At one time, it was believed that these were different species of animals but the similarity in the structure of the scales on the guard hair disproved such belief.

of the surface could be obtained either by reflected or by transmitted light. Bleaching out of the pigment has been tried but quite often the surface of animal fibers is affected by the alkali contained in the bleaches, so that the finely etched edges of the serrations on the cuticular scales became partially or completely lost, resulting in inaccuracies of analyses and identifications.

Other suggested methods have been by the use of sheet plastics in which the surface is softened sufficiently to permit the specimen to be impressed into the plastic. Good results are obtainable by this method but it must be used by experienced technicians who can carefully estimate and govern the amount and the strength of the chemicals used, the degree of heat, and the amount of pressure to be applied. Its greatest drawback is that it cannot be done rapidly.

The method here suggested is simple, the materials easily obtainable, and it requires very little instruction to laboratory assistants who, after a few hours instruction and use, can usually obtain successful results. We have worked with this method for a few years and find that it has also been used by foreign technicians[1]. Up to recently we have used glass photographic plates 2¼ x 3¼ inches in size. These plates are fixed until perfectly clear in the same hypo solution we use in our photographic work, and washed for ½ hour. The non-halation backing is removed with cotton saturated with soap.

We use this size of plate because it is most conveniently handled on the stage of the microscope, but other sizes can be used just as well if found to be more convenient.

After washing, the plates are partially dried. The proper amount of moisture left in the plates can be determined by observing the emulsion near the edges of the plates. At these edges, to only a very slight margin, the emulsion should be quite dry and the emulsion in the rest of the plate in a well dampened state. This partial drying of the plates should be done carefully at room temperature in the absence of any dust or currents of air, otherwise dust particles will adhere and uneven evaporation take place. The best way to do this we have found, is to stand the plates on edge in a beaker over which is placed a glass cover, and enough air will penetrate through the spout to aid evaporation; this usually takes 20 to 30 minutes.

The plates are placed emulsion side up on a hard smooth surface, such as a stone laboratory table or a sheet of plate glass. The specimens are now dropped singly on the moist emulsion and then covered with a piece of thick soft plastic, such as cellophane, to prevent the specimens from being crushed when weight is applied to them.

On top of the plastic cover, a thick glass plate is placed to protect the plastic from uneven pressure, and on this glass plate are placed

[1] See "Atlas Der Menschlichen Und Tierischen Haare, by Th. Lochte, Göttingen.

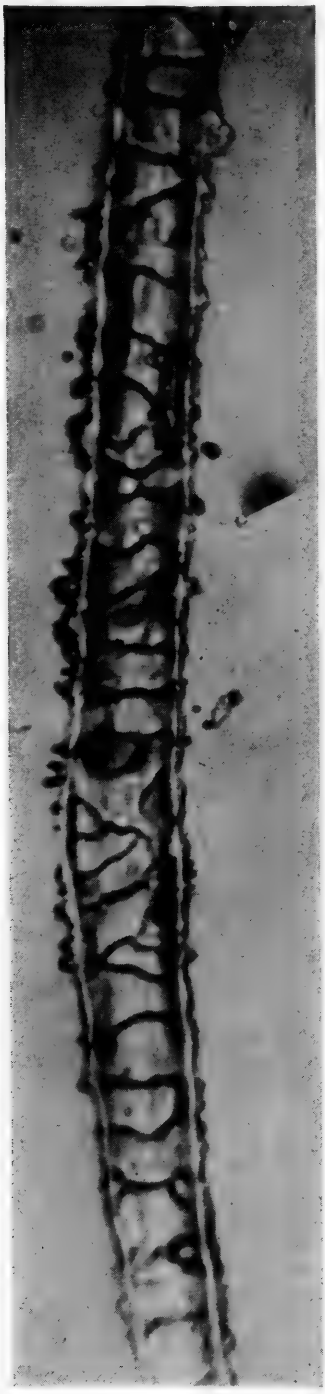

Figure 6. Processed wool from product known as Mouton-dyed Lamb. An interesting observation can be made of the adherence of fat to these wool fibers which appear as small irregular globules along both outer edges of the fibers.

Figure 7. Beaver fur fiber. The scales on the hair covering of fur-bearing animals differs with each species, as noticeable with these two specimens.

books or other heavy objects in which the weight is evenly distributed. Ten or fifteen pounds of weight is all that is required.

Up to this point, the time consumed should be less than one hour. Specimens are left under weight for about fifteen to thirty minutes but no longer; the weights, glass and plastic are then removed and the photographic plate is again placed on end in a beaker and covered with a watch glass to keep the dust from settling on the emulsion. When thoroughly dry, the fibers can be blown off or easily removed by brushing with a soft camel's hair brush. Our usual procedure is to impress our specimens late in the afternoon and leave them to dry overnight, so as to be sure the emulsion is thoroughly dry before we brush the specimens off.

No cover glasses are required for examination under the microscope inasmuch as we now have an indented mould in the emulsion; no mounting medium can be used as this would fill up the specimen-mould and lower its visibility.

With proper care, these plate molds can be kept for years; all that is required is a dust-proof box, and wax paper separation placed between each plate.

Recently, we have found that the Eastman Kodak Company is manufacturing gelatin-coated slides for refractive index immersion mounts, and have purchased some from the Will Corporation. These slides are 25 x 44mm, which is smaller than the usual 25 x 75 microscopic slides; we have requested the larger slides as that size would be handier when filing them in the regular slide cases.

Figure 8. Mink guard hair taken at its basal section. Here we see a distinct seasonal change in the shape of the scales as the weather changes from winter to spring; the hair during this seasonal change gradually becomes thinner toward the base because of the construction of the follicle unit it becomes so narrow that it breaks off and is shed or molted.

Peritoneoscopic Photography

Allen F. Hancock*

WHEN disease of the abdominal organs is suspected but cannot be proven by ordinary clinical and laboratory means, an extensive exploratory operation may in some instances be avoided by using the peritoneoscope. Not only can the abdominal organs be visualized and photographed, but small pieces of tissue may be safely removed for microscopic examination. If there is excessive fluid in the abdominal cavity it can be drained off through the peritoneoscope, which procedure is necessary to permit clear visualization.

In this discussion we are primarily interested in the means of making peritoneoscopic photographs as an aid to diagnosis and for permanent records. We use a Robot camera which is especially equipped by the American Cystoscopic Makers, Inc., for endoscopic photography. This camera is chosen because of its automatic film winding mechanism which eliminates undesirable waste of time and possible trauma involved in hand winding. After the camera is loaded, one need only wind the spring motor to have 24 exposures available without further manipulation.

Though the disadvantages of slow color film are obvious we feel that the additional diagnostic value of color photographs justifies its use. Consequently we make all exposures on Kodachrome 135A, and resort to black and white copies if such reproductions should be required for

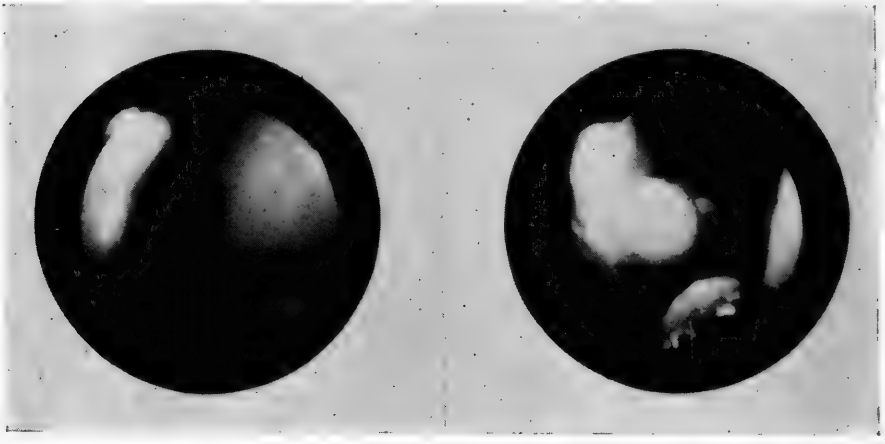

Figure 1. Peritoneoscopic views. Copied from Kodachrome.

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* Biological Photographic Unit, Division of Hematology, Charlotte Drake Cardeza Foundation, Jefferson Medical College and Hospital, Philadelphia, Pa.

publication, figure 1. Before loading, the film must be removed from its cartridge and wound into the removable cartridge of the camera. After exposures have been made the film is returned to its original cartridge to be sent off for processing. Since 24 exposures are made on a film designed for 18 standard 35mm by 25mm frames, Eastman returns the roll intact. No special instructions to them are necessary.

Illumination for the photographs is obtained by overloading the lamp of the peritoneoscope. The electrical connection is made by attaching the short cord on the camera, figure 2A, to the contact on the telescopic portion of the peritoneoscope. The cord from the battery box, which should contain fresh batteries, is plugged into the camera at B. This permits an automatic step up of the current during exposure.

The camera clips easily onto the regular eyepiece of the telescope if it is of recent manufacture. If the instrument was manufactured prior to the time when endoscopic photography was thought possible, it is likely that the eyepiece will not fit. Many viewers are equipped with a small indicating button on the perimeter of the eyepiece which will prevent the attachment of the camera. For the removal of this button, and for the now standard sized eyepiece the instrument should be returned to the manufacturer.

Once the camera is properly attached to the telescope the surgeon is able to make his visual examination through the supplementary eyepiece, figure 2C, supplied with the camera and attached just below the lens. The view is only obstructed during the actual period of exposure for photographs. The mechanism operates as follows: When the double cable release is plunged, the movable prism of the viewer pivots out of the direct line of light rays while at the same time an overload of current increases the usual amount of illumination supplied by the lamp on the telescope. The resistance is maintained during the time that the shutter is open. Since this entire procedure takes place automatically upon operation of the cable release, it is well to test the equipment, thereby wasting one exposure, before the telescope is introduced into the abdomen.

The procedure in the operating room is as follows: After the surgeon has made his initial examination the camera is attached to the eyepiece of the peritoneoscope, and the electrical contacts are rearranged to carry the current through the resistance device of the camera as described in the preceding paragraph. Once the camera is in position the surgeon may continue to examine the abdominal and pelvic organs through the supplementary viewer. In order to make exposures the cooperation of the patient is required, since he must hold his breath for the duration of the exposure. At the same time the camera must be held with an extremely steady hand. We do not recommend the use of a rigid support

for the camera, and have found that clear, still pictures are obtained with exposures even up to 6 seconds if deemed necessary. Experience has shown that for best results the surgeon should touch the area to be photographed with the tip of the instrument and then withdraw

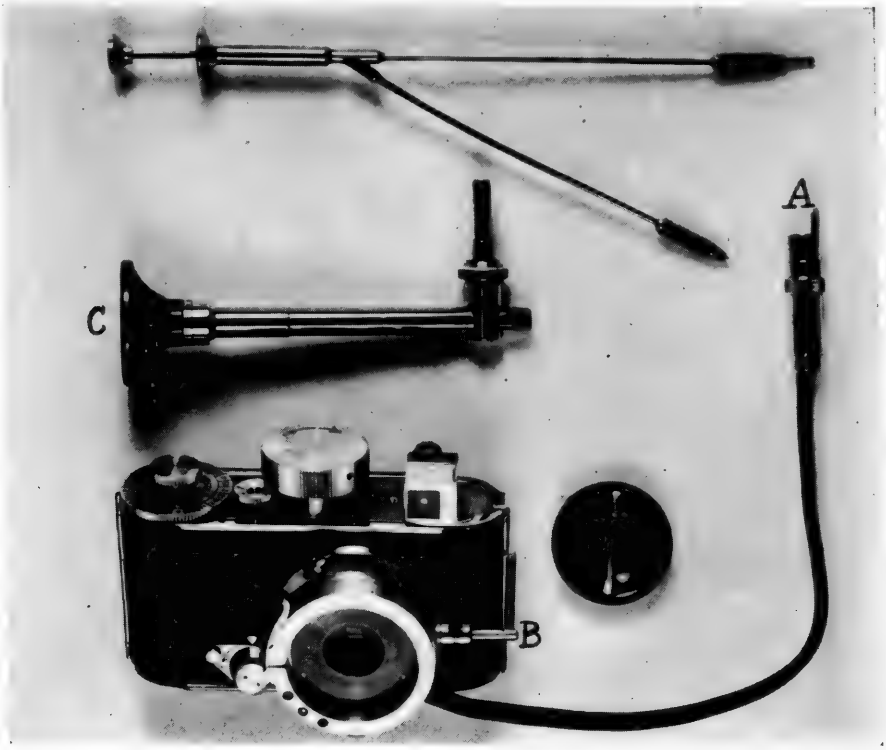


Figure 2. Robot camera equipped for endoscopic photography.

it 2 inches before making the exposure. The average exposure is three seconds. Surest results, especially for the beginner, are obtained by making several exposures at different speeds of each area desired.

At times the light bulb of the instrument becomes clouded. The surgeon can alleviate this condition by pumping more air into the abdomen, or by removing the instrument to wipe off the lamp. This is necessary since the peritoneoscope, unlike the cystoscope, operates only in air, and not in fluid.

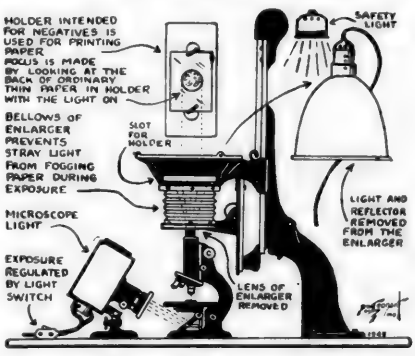
SUMMARY

The requirements for peritoneoscopic photography are the properly equipped camera, which is adaptable to all forms of endoscopic photography, and the cooperation of surgeon and patient. The time consumed by the photographic procedure is negligible if the photographer employs the technic described.

CURRENT PHOTOGRAPHIC ABSTRACTS

Photomicrography: A Short Method Using Negative Projection Prints. Donald W. Leonard, M.D., F.A.C.S., Cambridge, N.Y. J. Lab., Clin. Med. 31:373 (March) 1946. ... Out of the need for self-made photomicrographs has developed a suggestion that any medical author can resort to the use of a negative projection print whenever he needs a photomicrograph for illustration. To the obvious advantage of requiring no more than the equipment already available can be added the claim that such a print will show a tissue section more nearly as it actually is—a thin slice of bloodless, white material outlined against a background of space, its delicate pattern of cells and nuclei sharply visible.

... Simplicity is the first advantage to be credited to a technique which makes prints on paper directly from the microscope slide. It is a darkroom technique but, in this respect, it is essentially the same as the step that has been used in the standard routine to get paper prints from negatives. It uses the slide in place of the negative and the microscope as the enlarger. ... To make a projection print, it is necessary only to arrange the microscope, the slide, and the light source so that the image will be projected onto the photographic paper. For medical illustrations, a moderate enlargement is all that usually will be desired so that suitable distance from the ocular of the microscope to the paper will seldom be more than a few inches. The entire assembly may be quite compact. The advantage of a scheme which obtains a finished picture in a single step will occur to anyone and the technical details of the process will be obvious to any physician having some knowledge of photography. It is not necessary in this discussion to do any more than illustrate a simple arrangement of my equipment (Fig. 1).


HOLDER INTENDED FOR NEGATIVES IS USED FOR PRINTING PAPER
FOCUS IS MADE BY LOOKING AT THE BACK OF ORDINARY THIN PAPER IN HOLDER WITH THE LIGHT ON
BELLOWS OF ENLARGER PREVENTS STRAY LIGHT FROM FOGGING PAPER DURING EXPOSURE
MICROSCOPE LIGHT
EXPOSURE REGULATED BY LIGHT SWITCH
SLOT FOR HOLDER
SAFETY LIGHT
LIGHT AND REFLECTOR REMOVED FROM THE ENLARGER
LENS OF ENLARGER REMOVED

When an individual has assembled a combination of his own available equipment, he will have to standardize certain values, the first being the strength of his light source as it effects the length of exposure which will be required for each magnification and for slides which vary in their staining. A few trial prints should establish these values. Projection printing paper registering various degrees of contrast may be tried, but sharp contrast paper (No. 3) with a glossy finish will usually be the choice. The framing of the pictures takes care of itself because the field selected will be framed automatically in the circle of the microscope lens. After the exposure has been made, the steps in development will be the same as those of normal photography.

Designing a Photo Copying Stand

Clayton B. Oliver*

WHEN a request was received from our editor suggesting that I submit an article covering some phase of my work in the photographic department of the Wayne University, College of Medicine, I was not only surprised but somewhat at a loss in so far as making a definite selection, since in the three years involved in reorganizing, equipping, and establishing a logical routine of operation, many rather specialized procedures were inaugurated and perfected to their functional conclusions. Mention was made of the excellent department developed during that period, and while all of us here at the school are very proud of our accomplishments modesty requires my revealing that this was in all probability an overstatement of the facts, for we also feel that much remains to be accomplished. Furthermore, I am convinced that what progress has been made is due chiefly to two factors, first, the splendid cooperation received from each individual and from every department of the institution, and secondly, by the application of all the scientific knowledge and procedure that could be injected in day to day work, resulting in an exactness of operation that permitted routine applications to be performed with more certainty and greater speed, simultaneously maintaining a strict standard of quality.

After the first confusion in narrowing down to a specific topic the one hereby presented was chosen for the definite reason that copying comprises the bulk of the medical photographer's endeavors, particularly if he be situated in a teaching program, hence equipment for this phase is of prime importance to him. Little mention will be made of cameras and lenses since this topic can be summarized by merely mentioning the facts that the view type is the more adaptable where only one instrument is to be employed, and that where much copying is to be done a lens of the process type (apochromatic if color is a consideration) is the logical choice, but any good anastigmat is adequate, particularly if used at or near the most suitable aperture, which for most types is one or two marked stops below maximum, and has the advantage of being more adaptable to normal types of work. Neither is this to be a treatise on recommended procedures for handling the various types of copy en-

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countered as this subject is thoroughly covered in the excellent handbook, the Kodak Data Book "Copying," and is also very efficiently discussed in Radiography and Clinical Photography issued by the Medical Department of the Eastman Kodak Company. In regard to the latter, the issues containing information of direct value are as follows:

Volume 19 Number 2, 1943; Copying Black and White Originals.

Volume 19 Number 3, 1943; Copying Colored Originals; (in black and white and Kodachrome).

Instead, as indicated by the title, it is my intention to discuss the design, with emphasis on function, of a copy unit which has proven under actual operation to be one of the greatest single assets to the department and its objective of efficiently handling routine work with the maximum speed, yet maintaining a high standard of quality in the finished product.

Whenever copying procedures occupy more than an occasional portion of the work to be done a separate, especially adapted setup is advisable, and if this work forms any large portion of endeavor two are convenient, one rather large unit to handle the large originals and a smaller one to permit greater ease of operation for the routine, somewhat smaller material such as typed matter, small charts, copies from books, etc. One of vertical design usually proving more satisfactory. The prime requirements in any case being rigidity and parallelism of all parts. For the latter case the Kodak Precision Enlarger stand assembly or any similar equipment serves the purpose admirably, while the larger unit usually must be designed and/or constructed by the individual. The factor of rigidity may be satisfactorily accomplished if the entire assembly is constructed of material of sufficient size, and the points of mounting lie outside the track arrangement. Never attach any such apparatus by centrally located points as this is entirely unsatisfactory due to the inevitable vibration factor injected. Raising and lowering of the camera from the forward position occupied by the operator is an important time saving factor.

In the illustration accompanying this article the unit used by the author is shown. The relative position of the points of attachment will be noted at A^{1-4}, while the most unique feature is indicated by B^{1}, consisting of a lamphouse utilized to project an image of the groundglass downward upon the copy. This at once indicates the field included and by means of lines placed upon the rough surface of the glass and parallel with its edges, both the point of critically sharp focus and the alignment of the copy in relation to the sensitive material can be ascertained with ease and accuracy. An extension which has proven of great value consists of a one inch line drawn upon the focusing screen which, when projected to the copy, indicates the scale employed by in-

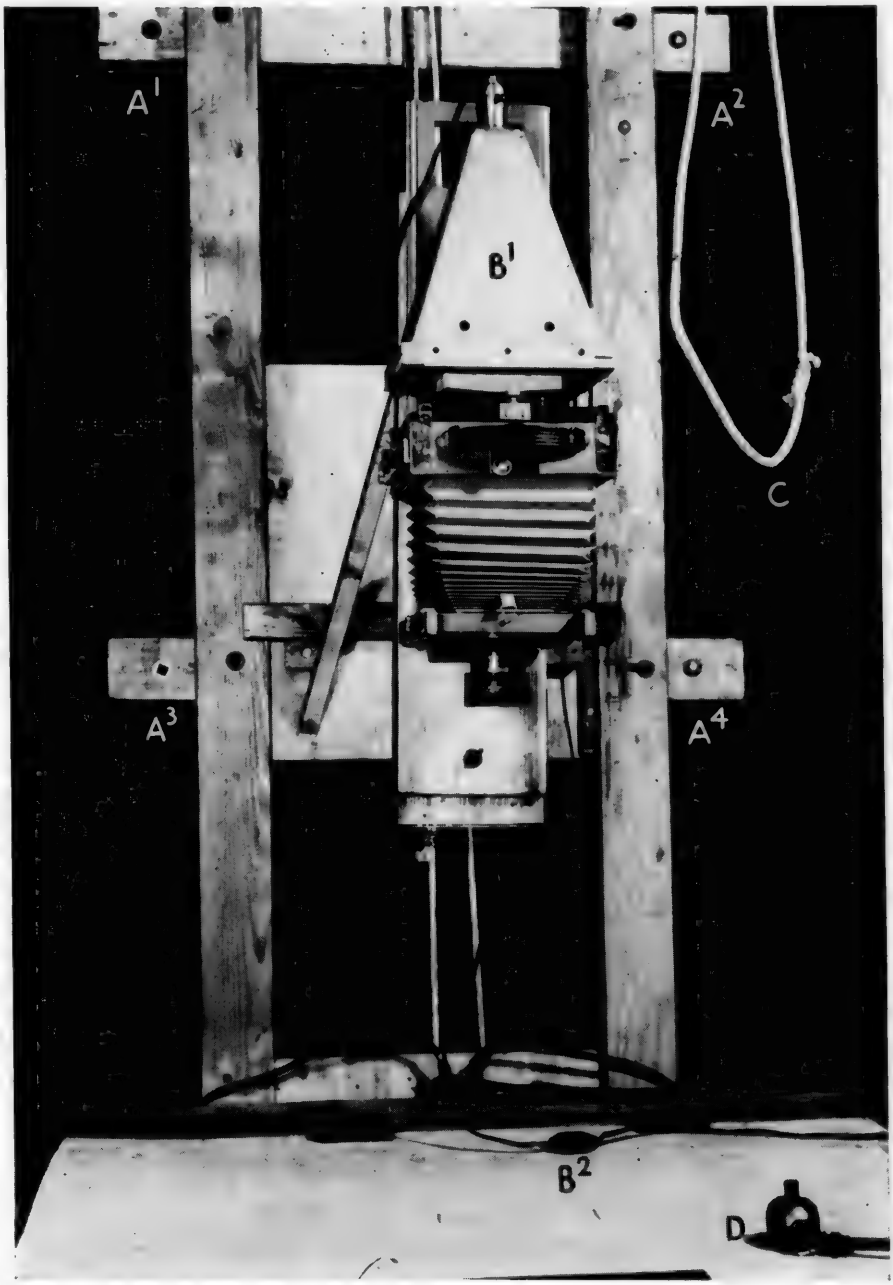


Figure 1

verse ration. If the projected image of this line measures two inches the reproduction scale would be one half, if three inches, one third, etc. This illuminator is controlled by an in-the-line switch shown at B^2, and is naturally turned off after copy placement, focus, and scale have been determined.

Control of the raising and lowering of the camera is accomplished from the normal position of the operator by the continuous rope shown at C, one end being attached to the top of the sliding block upon which the camera post is mounted and then run through a ceiling pulley, the other end being attached at the base of the same piece, run through a pulley at the bottom of the track and then back up through the usual ceiling pulley. Since the weight concerned has been matched by a counter-balance, a fairly easy pull upon the respective rope will either raise or lower the entire camera unit. A further refinement is shown at D, being merely a switch to control the copy lights from the camera position. In practice this unit has proven a very efficient time and labor saving device, permitting the photographer to concentrate on the photographic factors of his work, and as designed functions for a copy size up to 40 x 54 inch, with a choice of either 5 x 7 or 3¼ x 4¼ inch negative sizes.

In operation, the copy is placed upon the easel-table, the shutter and diaphragm opened, and the illuminator turned on. With the camera kept in approximate focus it is raised or lowered to include the necessary field of view, then critically focused. A ruler is then placed in the projected field (at the point of sharp focus should it be off the easel as when copying from a thick book) so that one end of the scale marker falls at zero, and the reproduction ratio determined by the length of the mark at that position. The illuminator is then turned off, the shutter closed, and the diaphragm set at the required aperture. The film holder can now be inserted, the copy lights turned on and the exposure made. The elimination of the necessity for looking in the ground glass can only be fully appreciated by actually operating a unit of this type, but it can be estimated from the fact that for the maximum copy size the camera is but sixteen inches from the ceiling and would require a step ladder to permit viewing the focusing screen itself. This height could be lessened by placing the copy at floor level, but it still would not eliminate the necessity of the ladder and would add the inconvenience of frequent stooping to place and withdraw the material. As designed this unit has a copy surface twenty-eight inches above the floor allowing this to be accomplished with no stooping whatsoever. It is felt unwise to give other dimensions as approximate proportions can be deducted from the illustration and the actual dimensions calculated to fit the individuals requirements of camera size, available space, etc.

Cinematography of Clinical and Surgical Subjects:

A General Consideration of Equipment and Technic

Leonard A. Julin*

MANY persons planning to start making motion pictures of clinical and surgical subjects have been asking for information about equipment and photographic technic. Questions often heard are, "What kind of a camera shall I buy?" "What lenses and other equipment do I need?" "What suggestions can you offer that will help me obtain good pictures of patients and of operations?" These are direct questions but I prefer to answer them indirectly by making some general statements that will permit the questioner to select the answers to his individual problems. The use of general terms will also aid in evaluating new kinds of equipment that will appear on the market.

EQUIPMENT

The selection of a camera should be made only after consideration has been given to a number of questions such as, "How will the completed films be used?" "What subjects will be photographed," "Under what conditions will the camera be used," "How much money can be invested in the equipment?" In addition, the purchaser may have likes and dislikes that will influence his choice of a camera.

The question relating to the use of the completed films was mentioned first because it arises immediately when comparing the merits of 8 mm and 16 mm motion picture film and equipment. Some physicians have been using an 8 mm camera to make motion picture records of some of their patients. The pictures are used as permanent records for reference and are not shown to large audiences. These physicians say that the small pictures are adequate and the cost of equipment and film is less than it would be for the 16 mm size. They state also that they use the 8 mm size because it is what they have been using for their personal home movies. However, a few have added that they hope to change to 16 mm equipment because of its advantages. On the contrary,

* Section on Photography, Mayo Clinic, Rochester, Minnesota. Received for publication May 2, 1946.

I have never heard anyone say that he wished to exchange 16 mm equipment for the smaller size.

In cameras and projectors of comparable workmanship, the 16 mm equipment does not cost much more than the 8 mm size. The pictures on 16 mm film are larger and will record smaller detail in a "long shot" such as the full figure of a patient. Dust and scratches on the 16 mm film occupy a relatively smaller part of the picture and are not so disturbing in the projected image. The 16 mm films can be projected to greater size in large auditoriums, and many more rental films are available for the 16 mm projector than for the smaller one. At present, duplication of 16 mm films is more satisfactory than duplication of 8 mm films. Enlarged duplicates (16 mm) can be made from 8 mm films but they are of inferior quality, the loss of definition being especially noticeable in color films. The original cost of 16 mm film is greater than that of the smaller size but usually after a splurge of picture taking with a new camera it is used more judiciously and then the annual expenditure for the larger film is not as great as many persons seem to fear. A greater variety of equipment is available for 16 mm films and this is the size to use if sound recordings are to be added to the picture. Personally, I recommend the 16 mm size and I shall consider only this size in the remainder of this article. The technic used in photography is quite similar for both sizes. The type of subjects to be photographed should influence the choice of a camera. The simplest camera will serve very well for some subjects but other subjects may require a camera with reflex focusser, multiple speeds, revolving turret lens mount, extra film capacity, powerful spring motor for long scenes and adjustable shutter. The complex camera can do many things that are not possible with the simple camera, and it may be desirable to have this added capacity in reserve for future needs; however, the additional features add to the weight bulk and cost of the camera. In addition to using a camera for their professional records many physicians like to use the same camera for personal movies and they find that a heavy camera becomes very burdensome if carried with them on journeys. In this connection one might give some consideration to the camera which uses film magazines instead of film rolls. The magazine type camera is generally of light weight and small size. It is easily loaded with film and is not burdensome although a supply of films in magazines is bulkier than a similar footage in roll form. The magazine cameras have a capacity of 50 feet of film while roll films cameras can hold 100 feet or more of film. Some persons object to variations in the placement of frame lines between pictures that may result from differences in individual film magazines. The magazine type camera is simple to operate, is relatively inexpensive and is quite satisfactory for clinical photography in many instances. A more versatile camera of the roll film type

should be selected if a great variety of subjects is to be photographed under various conditions. Such a camera may prove to be more sturdy and have fewer mechanical breakdowns than the magazine type of

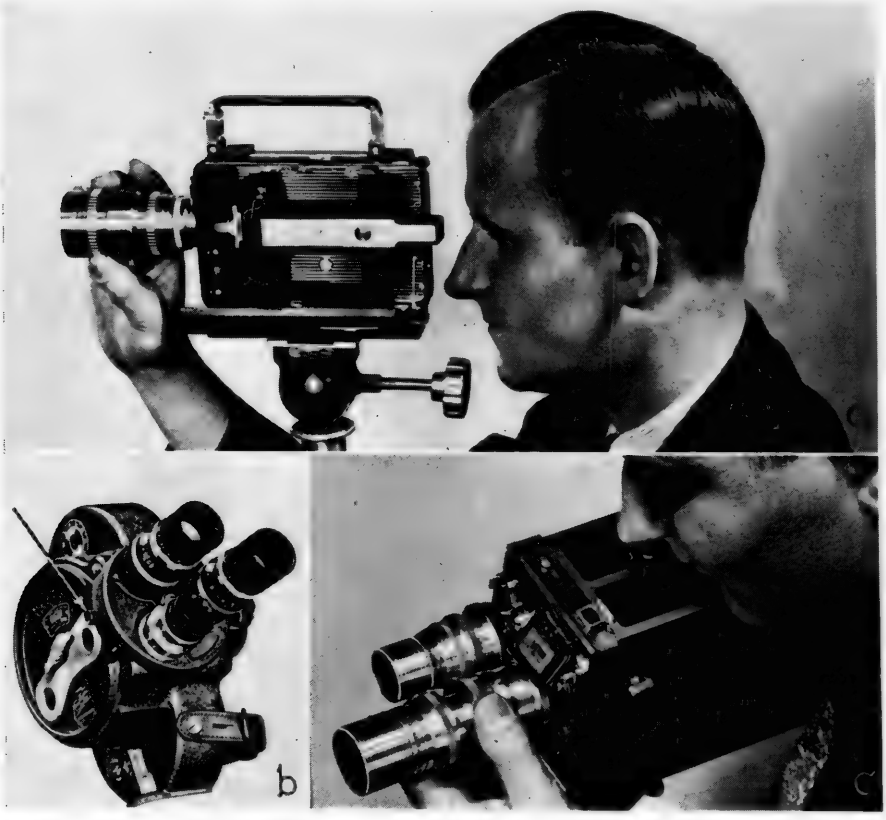


Figure 1a. Magazine camera (Magazine Cine-Kodak) showing focus finder placed in film compartment to permit checking focus and field; b, roll film type of camera (Filmo 70-DA); arrow points to peephole used for checking focus only; field finder is on the opposite side of the lens turret; c, roll film type of camera (Cine-Kodak Special) showing reflex focuser for checking focus and field while lens is in operating position.

camera. The capacity of the spring motor varies greatly in different models of cameras. Some cameras will operate only twelve seconds before rewinding of the spring motor is necessary while other cameras will run three times as long on one winding. In some cheap cameras the motor runs down gradually before stopping and this results in uneven exposure of the film. In the better cameras a speed governor stops the mechanism before there is harmful loss of speed.

Under what conditions will the camera be used? Good motion pictures of surgical procedures will require a roll film camera fitted with a turret lens mount and a means of focussing the image through the lens. Several lenses of various focal lengths will be needed. For clinical subjects this camera is desirable but not necessary. A simpler roll film camera or a magazine camera is adequate for most clinical subjects and a single lens is sufficient because the camera can be moved near to the subject for "close-up" pictures. Accurate focus can be obtained by measuring the distance from subject to camera and adjusting the lens accordingly. For pictures of surgical subjects the camera must be kept at a safe distance from the surgical field and if "close-ups" are to be obtained it is necessary to use telephoto lenses. In the operating room, the camera is seldom used more than 7 feet from the subject. At this close working distance, the high-power telephoto lenses have a very shallow depth of field so it is necessary to focus the image through the lens. By such means one can also be certain that the subject is centered correctly in the picture because the usual view finder is not reliable when a telephoto lens is used so close to the subject. A revolving lens turret fitted with lenses of various focal lengths is a convenience in quickly changing the magnification in the picture during the course of the surgical procedure. Only in very few instances can one obtain satisfactory surgical pictures with a simple camera equipped with a single lens. It is possible to use a magazine type camera and telephoto lenses if one also uses an accessory focus finder but this results in undue delay in the procedure because the film must be removed from the camera each time that the focusing device is used. Such delay is not serious, however, when this equipment is used for subjects of a clinical nature. Figure 1 shows three typical cameras and how they can be focussed critically.

What lenses are needed? The 1 inch (25 mm) lens is standard equipment on 16 mm cameras and lenses of various speeds, such as f. 1.9, f. 2.7 and f. 3.5, are available in this focal length. The f. 3.5 lens is the least expensive; it transmits less light than the others but it can be used if sufficient illumination is available. It is supplied in a universal focus mount or in a focussing mount. The latter mount is required for medical photography. The f. 1.9 lens is preferred because it transmits much more light and this is an important factor because it is usually difficult to provide much illumination over a large area such as required when photographing a patient who is walking. A telephoto lens is not often needed for clinical subjects but it is a convenience for some close-ups, especially if the patient is bedridden. A 2 inch (50 mm) or 2½ inch (63 mm) lens supplies ample magnification and the speed of the lens is not of great importance because adequate illumin-

ation can be provided for the small area being photographed. The cost of the lens may be a more important factor.

For surgical subjects, telephoto lenses are necessary and I have found the following set of lenses quite satisfactory: 1 inch (25 mm) f. 1.9, 2 inch (50 mm) f. 3.5, 3 inch (75 mm) f. 4.5 and 4½ inch (114 mm) f. 4.5. The illumination is standardized for the f. 4.5 telephoto lenses; therefore, faster lenses are not needed. A point to consider is that a fast telephoto lens may be so bulky that it crowds other lenses off a lens turret.

A tripod or other firm support should always be used with a motion picture camera. The tripod selected should be of a type that will not collapse on the slippery floors usually encountered in clinical photography. The center-post type of tripod is safe in this respect and its height is easily adjusted. It is not as rigid as some other types of tripods but is satisfactory for clinical subjects if it is used carefully. A specially constructed camera mount may be desirable for clinical subjects and is almost a necessity for surgical subjects for which a very rigid support is of great importance. A pan-and-tilt tripod head is very useful for both clinical and surgical photography. Many styles are available but I prefer the kind that can be freed or locked with a single twist of one hand.

The selection of lighting equipment will depend on the individual working conditions. In general, a number of floodlights will be needed if one is photographing a patient who is walking. For close-ups a single lamp may be sufficient. A spotlight is useful for crosslighting, to emphasize surface texture or contour. If the equipment is to be carried about in a hospital, consideration should be given to portability and also to the amount of electricity in the hospital rooms. For general illumination with color film (Kodachrome, Type A), I prefer to use No. 4 photoflood lamps in reflectors. The smaller reflector flood lamps and reflector spot

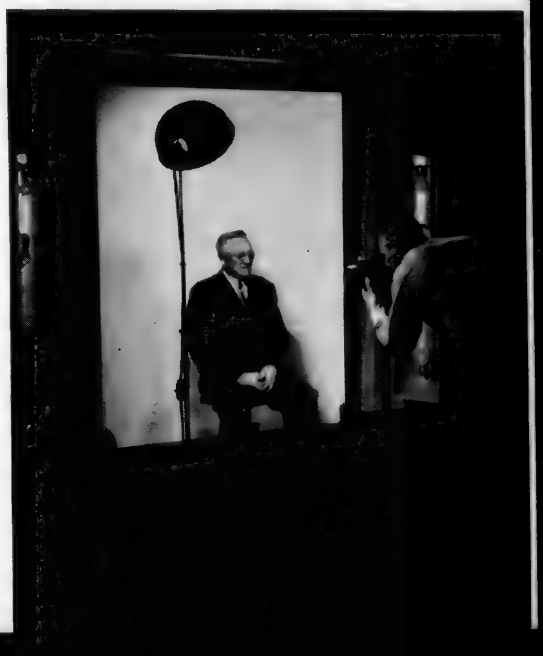
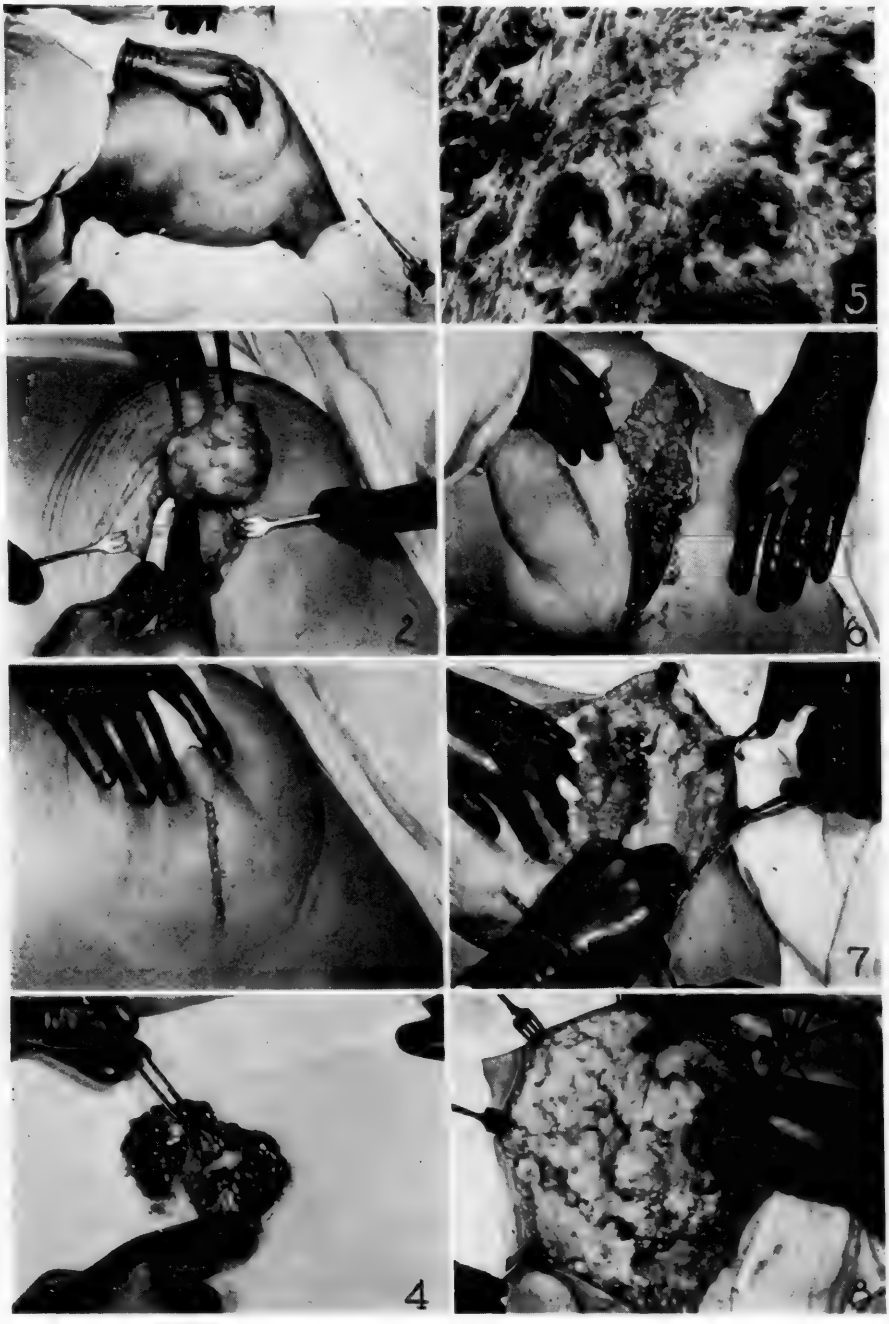


Figure 2. A setup for photographing clinical subjects. One No. 4 and one No. 2 photoflood lamps are being used. Background on casters is provided with a white surface on one side and a dark gray surface on the reverse side. Medium tone drapes are drawn across end of room and used as a background if subject is walking. Additional lamps are used when necessary.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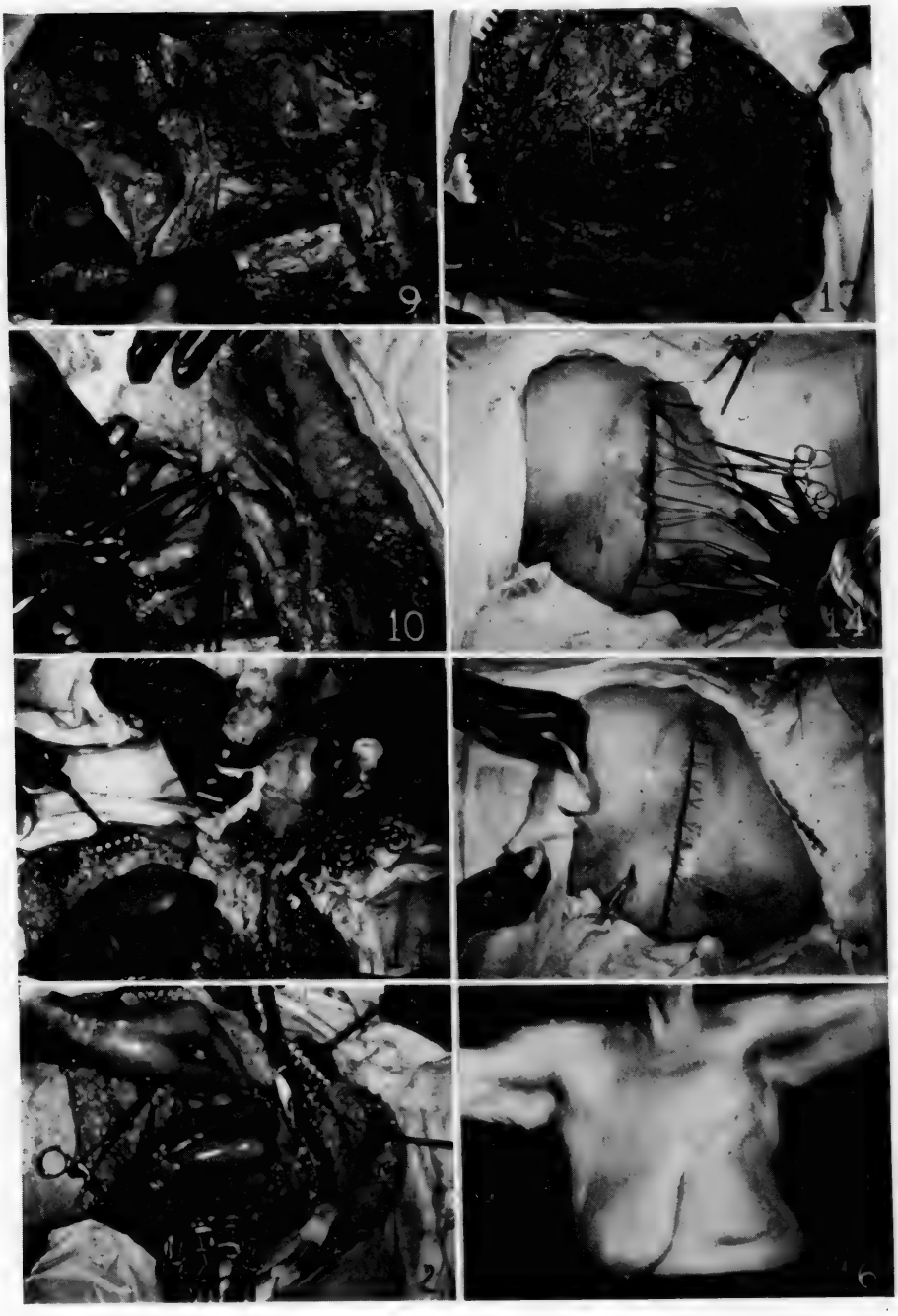

See Legend Page 178

lamps are very efficient but they furnish light which is too intense for the patient to look at unless diffusers are used. A good exposure meter is useful in determining the lighting requirements. For surgical subjects, a lamp which projects a converging beam of light into the surgical field is preferred because it produces soft shadows. A spotlight having a parallel beam of light produces dark, sharply defined shadows that are disturbing. A floodlight illuminates an unnecessarily large area and is uncomfortably hot for the surgical team.

TECHNIC

Clinical subjects.—Motion picture photography of patients is not difficult when it can be done in a photographic studio. Then the lighting can be standardized so that correct exposure is always obtained and a suitable background can be provided. Figure 2 shows a typical setup in a small studio. A plain background of light or medium tone is better than a black one. If a full-figure picture is made of a patient standing in front of a black background, the greater part of the picture area will be black. Then, if black and white reversal film is used, the processing laboratory will treat the film as if it were underexposed film and, in trying to compensate for underexposure, the detail in the important part of the picture will be "washed out." A black background does not reflect light back to the subject and, when color film is used, the shadows may be slightly underexposed, resulting in a ruddy appearance of the shadows along the sides of the subject. The tone of a light background can be controlled by the amount of illumination it receives in relation to the light falling on the subject. The subject should be several feet in front of the background to avoid distracting shadows on the background. For a full-figure picture, the main problem is to have the entire picture area illuminated adequately. The image of the sub-

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LEGEND FOR PAGE 176-177

Plate I. Radical Mastectomy. A series of black and white enlarged copies made from a 16 mm color (Kodachrome) motion picture film.

1. *Position of patient and site of tumor.*
2. *Excision of tumor for microscopic diagnosis.*
3. *Closure of wound.*
4. *The surgical specimen.*
5. *Microscopic examination reveals adenocarcinoma, grade 3.*
6. *Incision for radical mastectomy.*
7. *Beginning dissection of upper skin flap.*
8. *Dissection of lower skin flap.*
9. *Dissection of fascia containing lymph nodes.*
10. *Cutting axillary vessels.*
11. *Mammary gland, pectoral muscles and regional lymph nodes removed in one mass.*
12. *Hemostasis by ligature.*
13. *Ready for closure.*
14. *Closure begun.*
15. *Closure completed.*
16. *Patient living and well six years after removal of cancer.*

ject is so small that it shows very little detail. If the subject's gait is being photographed, it may be more satisfactory to make part of the record showing the full figure and then move the camera closer and photograph the upper and lower halves of the body separately to show the face more detail. If the general distribution of skin lesions on the body is to be photographed, it is best to have the patient standing. Instead of making a full-figure "long-shot" the camera is placed close enough to include only the width of the body. The pictures are then taken while the camera is slowly tilted to show the patient from head to feet. This will show the distribution of the lesions with much better detail than a "long shot." Individual lesions can be recorded by a telephoto lens or by having the camera very near to the subject. Cross lighting will emphasize the texture. When using color film to record skin lesions and surface coloring, one should avoid overexposure of the film or the color record may show less color than is present in the subject.

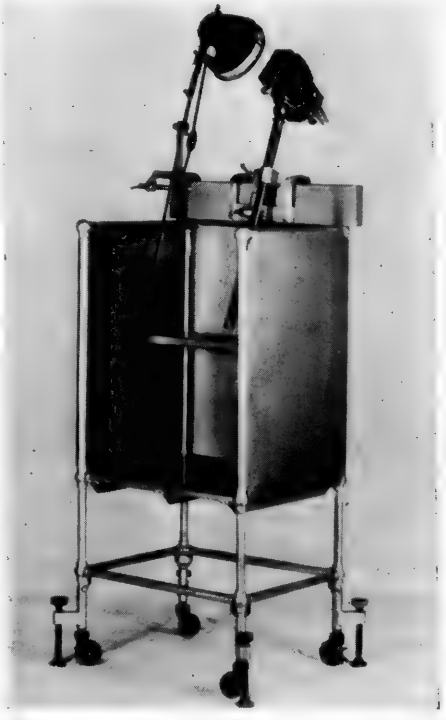

Figure 3. A specially constructed stand for photography in the operating room. Screw jacks support the stand rigidly after it has been moved into position. Sometimes it is draped with a sterile sheet. Usually, two lamps are used.

The most pleasing lighting for the face of a subject is obtained when the main source of illumination is above and slightly to one side and in front of the subject. A common error is to have two lamps at eye level, one at each side of the subject. This arrangement produces shadows along both sides of the nose and causes the subject to appear cross-eyed and scowling. The subject should not look into the lens of the camera unless the eyes are to be emphasized in the picture. This is not so important in still photography but if the subject stares at the motion picture camera it is very distracting on the projection screen. At all times, when taking motion pictures, it is well to think of the appearance and effect of the completed pictures as they will be seen on the projection screen. The film will have greater interest if the field of view is varied. It is customary to start the film with a general scene showing the subject and then follow with close-ups to show detail. It is well to have the patient rehearse his movements so that he knows what is expected of him. This enables the photographer

to follow the action more smoothly with less waste of film. The picture should be truthful; therefore, the patient should not be asked to look happier or sicker than he feels; however, many persons are camera-shy so the photographer should endeavor to obtain the expression that the subject would have if he were not facing a camera.

Motion picture photography of a patient in a hospital room may offer some difficulties owing to limited working space and limited supply of electricity. The limited working distance may be overcome by panoramming the camera to include all of the subject. A wide angle lens may be desirable in rare instances but I prefer not to use it unless absolutely necessary. The electric circuits to hospital rooms are commonly protected by 15 ampere fuses. If this is the case, one can estimate the amount of illumination that can be used safely. At 115 volts, the No. 1 photoflood lamp uses 2.2 amperes, the No. 2 photoflood lamp uses 4.4 amperes and the No. 4 photoflood lamp uses 8.7 amperes. If hospital equipment is using the same circuit, it is wise to have the house electrician present with extra fuses to avoid any harmful delay in replacing a burned out fuse.

The use of an unobtrusive background is very important. Bed screens can be used to hide objectionable objects in the background or they may be subdued by keeping them in shadow. A bed sheet or plain blanket makes a good background and white bed sheets can be used as reflectors in order to keep the number of lamps at a minimum. Any moving objects in the background are very disturbing in motion pictures and should be avoided. Sometimes one can find an idle room or hallway, in the hospital, that can be used as a temporary studio. If the patient can be brought to such a place it will result in better pictures and eliminate some of the difficulties for the photographer. The identity of each patient and the date can be recorded on a slate which is filmed briefly before the subject is photographed. It is also convenient to have, for each reel of film, a card on which is recorded the same information plus a record of the film footage used for each subject.

Surgical subjects.—The filming of surgical procedure is a very interesting assignment for the photographer but it presents him with a number of difficulties. His freedom of movement in the operating room is usually very limited and he must adapt his equipment and behavior to minimize disruption of the surgical routine. For most operations, an elevated position for the camera offers the best view of the surgical field. This is generally obtained in the observation gallery or from the top of a table or special stand on the floor of the operating room.[1,2,3,4] Figures 3 and 4 show equipment in use at the Mayo Clinic. Since local conditions vary considerably, the photographer should acquaint himself with con-

[1] Creer, R. P.: Apparatus for making surgical motion pictures. J. Biol. Phot. Assn. 1:23-25 (Sept.) 1932.

[2] Julin, L. A.: Surgical motion pictures: equipment and technic. J. Biol. Phot. Assn. 6:25-32 (Sept.) 1937.

[3] La Casas, H. de: How we make surgical films. J. Biol. Phot. Assn. 8:9-18 (Sept.); 80-86 (Dec.) 1939.

[4] Payne, W. F.: Photography in the autopsy room. J. Biol. Phot. Assn. 13:21-28 (Sept.) 1944.

Figure 4. Camera and lamps mounted in observation gallery of operating room.

ditions existing in the operating room that is to be used for motion picture photography. When not in use, an operating room has the appearance of spaciousness with an abundance of floor space for the photographer's equipment. This is misleading; therefore, the room should be observed while an operation is in progress. At that time, in addition to the surgeon and his assistants, the anesthetist and nurses will need room to perform their duties. In the performance of these duties, they may limit the view of the surgical field for the photographer. In addition to the people in the room, there may be several instrument tables, wastebaskets, wash basins, small platforms, an anesthetic gas machine, electrosurgical unit and floor lamp, which further limit the working sphere of the photographer. Since the electric equipment may use the same circuit that is to supply the electricity for the photographic lamps, the photographer should make certain that his lamps will not overload the circuit.

The aseptic routine of the operating room places additional restrictions on the photographer by requiring that he photograph from a safe distance. This distance makes it necessary to use telephoto lenses to obtain a large enough image on the film. The narrow angle of these lenses, however, aids in excluding the heads and shoulders of the surgical team from the pictures. While the lenses magnify the image of the surgical field they also amplify any unsteadiness in the camera, therefore, it must be supported on a firm support. A suitable tripod may be used but a more compact mounting can be devised to fit local working conditions. The photographer's lamps also should be supported securely so that they will not topple over. The ordinary operating room lights may provide sufficient illumination for motion picture photography but they are usually inconveniently situated for manipulation during the course of an operation. In addition, they may not have the correct color temperature for use with color film. The best results are obtained by using photographic lamps placed very close to the camera where they can shine into the surgical cavity. The sensitivity of the film and the effective aperture of the lenses will roughly determine the necessary amount of illumination on the area to be photographed. If the largest aperture of the telephoto lens is f. 4.5, it is necessary to provide enough illumination for correct photographic exposure with that aperture. A

telephoto lens of the same focal length and having a larger aperture may be used with less illumination but the shallow depth of field obtained under such conditions may be very unsatisfactory. A single lamp of sufficient brightness may be used but I have found it preferable to use two lamps of less intensity. During unimportant steps of the operation that are not photographed, one lamp may be turned off or both may be dimmed by means of a high-low switch.

The exposure meters which are available at this time are not of much value when filming surgical procedures because the meter cannot safely be brought sufficiently close to the sterile area to indicate the correct exposure. The illumination on the site of operation may be measured before the start of the operation but the indicated exposure will be correct for the incision only. Deep cavities and tissues of dark color absorb much light and require additional photographic exposure. Probably the best plan is to make some test exposures with standardized lighting and thus determine the necessary exposure for existing conditions. Thereafter, one can generally guess correct exposure under the standardized lighting.

For color photography, it is important that the lamps have the color temperature recommended by the manufacturer of the film being used. The lamps so recommended for use with Kodachrome Film (Type A) are photoflood lamps.[5] Photoflood lamps in the smaller sizes have a short life, however, and during the course of a long operation they may burn out or lose their efficiency. To avoid this difficulty, I have used 105 volt (500 watt, T-20) lamps on a 115 volt circuit. The resulting color films have been satisfactory. The lamps have a long life and are discarded when they become noticeably blackened. Fluctuations in line voltage cause marked changes in the color of the illumination and should be avoided if possible. It is generally understood that daylight and artificial light should not be mixed when color film is used. A moderate amount of daylight in the operating room seldom causes difficulty because so little reaches the operative field when the surgeon and his assistants are crowded around the operating table.

If the photographer is not already familiar with the operation he should have a previous consultation with the surgeon who can then describe the steps of the operation that are to be photographed. This will avoid wasting film on unimportant details. If the photographer has this information, it is insurance against failure to record any of the important steps because, during the performance of the operation, the surgeon may become so engrossed in his work that he may forget, at times, about photography. At this consultation, the photographer also can learn about the site of the incision, the position of the patient on

[5] Tuttle, H. B. and Henn, H. J.: Surgical motion pictures with 16 mm Type A Kodachrome. J. Biol. Phot. Assn. 5:63-74 (Dec.) 1936.

the operating table and where the surgeon will stand while he is operating. Thus, when the photographer arrives at the operating room, it is not necessary to ask questions which may cause delay and disturb the patient if he hears them.

In the operating room the photographer should endeavor to be unobtrusive and remember that all the activity around him is for the welfare of the patient and is not a performance for the benefit of the cameraman. He is expected to obtain good pictures without disturbing the operative routine but, at the same time, he can expect co-operation from the operating room personnel. Having explained the operation to the photographer, the surgeon will usually expect him to decide where he thinks the camera should be placed for the best view of the surgical field. For most operations, this is obtained when the camera is "sighted" along the length of the incision or over the right shoulder of the surgeon (if he is right handed) but each case must be considered individually in this regard. If the camera is mounted in the observation gallery, the photographer may request that the operating table be moved nearer or rotated to aid in obtaining better pictures. This should be done before the patient has been draped with sterile sheets, and the new position of the table should be subject to the approval of the operating room personnel. If the photographer is working on the floor of the operating room, he may be able to shift his equipment more freely but this should also be subject to approval. If explosive anesthetic gases are used in a well ventilated operating room, there is little likelihood of danger from the photographic lighting equipment if it is not used near the source of the gas. This matter should be discussed with the anesthetist as a matter of precaution. What should the photographer wear in the operating room? This can be answered by the operating room supervisor who will also provide the necessary outfit.

Before the start of the operation the equipment should be set up and properly placed. The equipment that may be needed includes various lenses, an ample supply of films and a pencil for numbering each roll of film after it is exposed. It is well to film a short scene showing the position of the patient on the table before he is covered with sterile drapes; otherwise, it may be difficult to recognize the site of the operation. I generally use the one inch (25 mm) lens for this scene and then use the 2 inch (50 mm) lens to record the incision. During the course of the operation, the photographer uses his judgment in deciding what other lenses to use. As a general rule, I prefer to use the lens that gives the highest magnification while retaining the desired area of interest. Plate I shows fields of various sizes in a typical film of a surgical procedure. Before each scene is photographed, the cameraman should make certain that the subject is still in focus and is centered in the picture, because the telephoto lenses are extremely critical when used near the

subject. The cameraman must work efficiently and quickly so as not to delay the surgical procedure. When it is necessary to reload the camera, the surgeon should be informed so that he will not begin an important step of the operation before the camera is ready for use. Photographic exposure is not much of a problem after the correct exposure has once been determined for a standardized lighting. When using Kodachrome Film (Type A) with beams from my two lamps superimposed on the surgical field, the usual exposure is at f. 4.5 for a deep cavity or an area of dark color. For areas of light color and for the skin incision the usual exposure is at f. 5.6. When using the one inch (25 mm) lens to show the position of the patient, the lamps are directed separately over a larger area and the exposure is at f. 3.5. These apertures have proved satisfactory when the pictures were made at the rate of sixteen frames per second. For scenes of general activity in the operating room, it would be necessary to use floodlights to illuminate large areas and, under such conditions, an exposure meter could be used. The filming of a surgical procedure is not especially difficult but the photographer must remain constantly alert or he may sadly discover that the film is of no value because a single scene was out of focus or the subject was shifted out of the picture.

EDITING

When the processed films have been assembled they can be improved greatly by judicious editing.[6] In the usual surgical film there may be many short bits that are of no value because the field of view was obstructed by a member of the operating team. After these bits have been cut out, the film is reviewed and cut a number of times until the action moves smoothly throughout the film. The film is then ready for the addition of titles and other material that one may wish to include.[7] If the film is to be used many times, it is best to have a duplicate made before the original is damaged. If it is known that duplicates will be needed of a color film, one may obtain better duplicates if the original filming is done on a special color film which is designed for use as a master film only and is not suitable for projection. If a sound recording is to be added to the film, it is necessary that the pictures be made at the rate of twenty-four frames per second. This is 50 per cent faster than for silent films; consequently, 50 per cent more illumination is required. It also is necessary to have a completed script for pictures and sound before taking the first picture. In fact a "shooting script" for all motion pictures would result in films of greater effectiveness.

[6] Julin, L. A.: The editing of surgical motion picture films. J. Biol Phot. Assn. 8:128-131 (Mar.) 1940.

[7] Payne, W. F.: Film slides and movie titles. J. Biol. Phot. Assn. 14:77-89 (Dec.) 1945.

CHATS WITH THE EDITOR

World's Leading Scientists Talk Over Peacetime Problems

The world's leading scientists and engineers, men whose names and achievements dominated the headlines of World War II, met at Pittsburgh May 16, 17 and 18 at the George Westinghouse Centennial Forum commemorating the 100th anniversary of the birth of George Westinghouse, founder of the Westinghouse Electric Corporation. Included were leaders in the development of the atomic bomb, in medical and biological science, transportation, education and electric power.

The theme for the opening session was discussions on "Science and Civilization," with Dr. Robert E. Doherty, President of the Carnegie Institute of Technology, acting as chairman of the symposium.

First on the program was an address on "Scientific Ethics" by Dr. Archibald V. Hill, Foreign Secretary, Royal Society, England. Dr. Isaiah Bowman, President of Johns Hopkins University and world-famous geographer, geologist and educator, spoke on "The Social Composition of Scientific Power," and George W. Merck, President and Director of Merck & Company, who was chairman of the United States Biological Warfare Committee during the recent conflict, discussed "Peacetime Implications of Biological Warfare."

Dr. L. W. Chubb, Director of the Westinghouse Research Laboratories and an inventor with more than 200 patents in his own name, spoke on "Partners in Science."

Atomic Experts Speak

The Thursday afternoon session comprised a symposium on "The Future of Atomic Energy," with Dr. Frank B. Jewett, president of the National Academy of Sciences acting as chairman. This discussion featured such atomic experts as:

Dr. J. Robert Oppenheimer, Professor of Physics at the University of California; Dr. Enrico Fermi, Professor of Physics at the University of Chicago; Dr. W. Edward Chamberlain, Professor of Roentenology and Radiology, Temple University School of Medicine; and Dr. Hugh S. Taylor, Dean of Graduate School, Princeton University.

Dr. Oppenheimer discussed the "Explosive" phases of atomic research, Dr. Fermi the "Power," Dr. Chamberlain the "Biological" and Dr. Taylor the "Chemical."

At a dinner meeting following the atomic session, Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, who was chief of the U. S. wartime scientific high command, spoke on "Planning in Science."

The program for Friday, May 17 dealt with "Transportation—A Measure of Civilization," and "Biological Science."

First speaker on the Friday program was Dr. Edward Warner, President of the Interim Council, Provisional International Civil Aviation Organization, who discussed the "Aviation" phases of transportation. Vice Admiral Emory S. Land, U. S. Navy (retired) former chairman of the U. S. Maritime Commission, spoke on the "Marine" aspects of transportation.

Martin W. Clement, President of the Pennsylvania Railroad, talked on "Rail" matters and Dr. Charles F. Kettering, Vice President and Director of General Motors Corporation, spoke on "Automotive."

"Transportation Planning in Urban Areas" was the subject of Harland Bartholomew, civil engineer and city planning and transit expert.

Dr. Jewett was the speaker at the Friday luncheon meeting, discussing "Horizons In Communications."

The Friday afternoon symposium on "Biological Science" was under the chairmanship of Dr. Taylor. Dr. Cornelis B. Van Neil talked on "Light and Life—Photosynthesis" and Dr. George W. Beadle discussed "High Frequency Radiation and The Gene." Dr. Van Neil is Professor of Microbiology at Stanford University, Dr. Beadle is Professor of Biology at Stanford University.

STREPTOMYCIN DISCOVERER ON PROGRAM

Russian-born Dr. Selman A. Waksman, Professor of Microbiology at Rutgers University, and discoverer of the new "wonder drug" streptomycin, spoke on "The Microbe—Friend and Enemy of Man." Dr. Waksman was selected by TIME magazine as "Doctor of the Year" in 1945 for his discovery which provides a new weapon against tularemia, undulent fever, typhoid, infections of the kidneys and bladder and possibly tuberculosis.

Completing the Friday afternoon program was an address on "Molecular Architecture and Biological Reaction" by Dr. Linus Pauling, Chairman, Division of Chemistry and Chemical Engineering, California Institute of Technology.

A. W. Robertson, Chairman of the Westinghouse Electric Corporation, and director of several other concerns, was chairman of a dinner meeting Friday evening. Charles W. Kellogg, President of the Edison Electric Institute, spoke on "Electric Power—The Foundation of Industrial Empire."

Another address, on "Scientific and Engineering Progress—Insurance Against Aggression and Depression," was given by Dr. Karl L. Compton, President of Massachusetts Institute of Technology and one of the nation's most distinguished educators.

These intellectual contributions were distinguished by the clarity of their exposition. They were most enlightening and inspiring. Scientific achievements in all fields of research were summarized in a simple manner while the comments on future developments indicated still greater benefit to mankind.

Westinghouse has contributed a signal service to the scientific world in gathering together this group of the world's leading scientists and engineers. The correlation of all of the knowledge they presented will without doubt lay the foundation for future research that will contribute materially to the advancement of civilization.

LEO C. MASSOPUST

New Photo-Lab-Index Appears

The first post-war edition of PHOTO-LAB-INDEX, the cumulative formulary of standard recommended photographic procedures, published by Morgan & Lester, New York, publishers of photographic books, is expected to be ready for distribution early in June. For the first time, the PHOTO-LAB-INDEX will make its appearance in two forms:

The DeLuxe 8th edition of the PHOTO-LAB-INDEX will come in the familiar 6-prong, two-position *loose-leaf* binder of 3-inch capacity. In addition to the present 1200 pages, this binder is of sufficient capacity to hold forthcoming Quarterly Supplements for some time to come. Complete and up-to-date as of January 1, 1946, the DeLuxe 8th edition of the PHOTO-LAB-INDEX is priced at $15.00. The Quarterly Supplement Service is available for this edition. A subscription to this service for the year 1946 (Nos. 27, 28, 29 and 30) is still maintained at $2.00 per year, payable in advance directly to the publisher.

The Standard 8th edition of the PHOTO-LAB-INDEX, containing material and number of pages identical with that of the DeLuxe edition, is bound solid, in fine cloth, and is conveniently thumb-indexed with a guide to each of the 24 sections stamped upon the front and back covers. This edition is not loose-leaf and the Quarterly Supplement Service is not available for it. Up-to-date as of January 1, 1946, the Standard 8th edition of the PHOTO-LAB-INDEX is priced at $8.00.

News from the Trade

F. R. Harding*

Radiant Announces 1947 Screen Finder

A new, slide-rule type Projection Screen Finder for the users of opaque, movie, slide and strip film projectors has been introduced by Radiant Screens.

This screen finder lists information on the correct screen model to use and on the audience handling capacity of a given screen, in addition to permitting the solution of such problems as the correct screen size to use, the correct distance from the screen to the projector, and the correct focal length lens to use. This useful data is available by a simple movement of the handy slide and should prove invaluable to all projection screen users.

With all this information at his fingertips in a simple form, the user need never wonder whether he has the right lens and the right distance to the screen in order to provide clearly visible pictures for his entire audience. He won't have to place the projector in the middle of the audience nor will he be forced to squeeze all spectators into a small, uncomfortable area, because the correct dimensions will be available beforehand.

For further information, write to Radiant Manufacturing Corp., 1140 West Superior Street, Chicago 22, Illinois.

Portable Flash Units Released

Photographers who use flashbulbs in quantity will welcome the first Wabash Electroflash units announced by the Wabash Corporation, Brooklyn 31, N.Y. Designed to produce a minimum of ten thousand photographic flashes with a single repeating flashbulb, the unit is said to consume less current for a thousand flash pictures than a 100-watt bulb consumes in ten hours.

The first unit now being delivered to the trade is an AC portable developed in the electronics laboratories of Sylvania Electric Products Inc., and styled for studio, banquet and general indoor photography. It consists of a power pack operating the Electroflash bulb, and the Electroflash Gun with reflector and flashbulb. The entire unit with carrying case and all accessories weighs 21 pounds, and comes completely wired and ready to be plugged into any 115-volt AC line receptacle. After each flash the unit automatically recharges itself within 7 seconds flat, and can be flashed as often as desired allowing 7 seconds between flashes.

* Children's Hospital, Boston, Mass.

It can be operated by remote control push button held at the camera, or by synchronization with any camera shutter including the newer shutters with built-in synchronizer contacts. For multiple flashwork, it can be hooked up with any additional units or with the Wabash Studio Unit and other models to be ready soon. Since the Electroflash Gun fits any standard camera synchronizer bracket and has a flash cable 11 feet long, photographers can rest the power pack anywhere and hold camera with flashgun as much as 11 feet away.

Heart of the unit is the specially designed flashbulb which produces a brilliant flash with an effective photographic duration of 1/5000th second. Its color is blue-white, closely approximating normal daylight and the Kelvin temperature of daylight type color films. In spite of its intensity and his peak quality, its extremely rapid flash produces no eye discomfort.

Retail list price of the AC Portable will be $160.00 complete. Two more models, a battery-operated portable and a Studio Giant are already in production and promised for delivery within thirty days. Full details can be had by writing Photolamp Division, Wabash Corporation, 345 Carroll St., Brooklyn 31, New York.

Lektra Develops Electronic Photo Timer

To meet the need for an electronic photo timer which will operate automatically on a contact printer or with a remote control foot-switch, Lektra Laboratories, Inc., 30 East 10th St., New York, announces development of the Lektra Model TM-5-R. The new electronic model retains the comprehensive interval range available in the Lektra Model TM-5.

When in use with a contact printer, contact is made from a special outlet in the TM-5-R to the platen switch of the printer so that when the platen is closed it automatically starts the timing cycle.

For enlargement work, a foot-switch can be inserted in the outlet so that the timing cycle can be started by a standard foot-switch.

In both enlargement and contact printer work, the electronic timer automatically stops the exposure at the end of the pre-selected interval.

The TM-5-R makes possible the selection of 105 time intervals, including 55 from .2 of a second to 11 seconds in steps of .2 of a second, plus 50 intervals from 11 seconds to 60 seconds in one-second steps. Accuracy is laboratory-guaranteed within .05 seconds or 10 per cent of the pre-set time interval.

The Lektra Model TM-5-R measures 5½ x 8 x 3¼ inches, weighs 3 pounds and operates on AC or DC.

Book Reviews

MEDICAL PHOTOGRAPHY by T. A. Longmore, A.R.P.S., M.S.R. The Focal Press, New York and London. 432 pages 5 x 7. One hundred fifty illustrations. Cloth bound. $7.50.

This book is divided into two parts: I. Radiography; II. Clinical Photography.

Under Radiography is discussed, x-ray materials, apparatus and accessories, exposure factors, the radiographic image, processing and other basic information.

The chapter on Clinical Photography covers: The principles of the camera, optics, negative materials, light filters, clinical phototechnic, processing with its allied procedures, miniature radiography, cineradiography, stereoscopy, photomicrography and other applications of photography in the clinical field.

This volume contains a great deal of basic information which is described in simple style and profusely illustrated.

Leo C. Massopust

JOURNAL OF THE HISTORY OF MEDICINE AND ALLIED SCIENCES Volume I, Number 1; January, 1946, edited by George Rosen, M.D. Published quarterly by Henry Schuman, New York. 182 pages, 6¾ x 10 inches, many illustrations, cut and bound in stiff paper.

It would be difficult to know how to present fine scholarship in a more dignified manner than it is presented here, and every serious student of the humanistic aspects of the sciences is honored by this newest of journals.

Such a work must not be the personal project of a single and circumscribed mind, with its "I" sprinkled liberally here and there; nor can it be irregular in all but its irregularity and uniform tardiness in publication. Neither must it fall a casualty in war—although the critic of what has been knows that it was not the war, but the passing of Oslerian Romanticism which made the casualty.

Oslerism still vegetates in some of the remoter morasses of backward thought. But the *Journal of the History of Medicine and Allied Sciences* is big with assurance and bright with contemporaneousness. The mind of George Rosen is not to be limited to a single point of view, and the roster of his associates and consultants ensures universality in scholarship and freedom from that stuffiness which has made most modern literature in this field simply insufferable. A critical realism that is abreast of the times, not behind them; today's thoughtful evaluation of all our yesterdays—if a man is looking for these, assuredly they are here.

G. Kasten Tallmadge

Replacements Sought for Devastated Libraries

During the war, the libraries of half the world were destroyed in the fires of battle and in the fires of hate and fanaticism. Where they were spared physical damage, they were impoverished by isolation. There is an urgent need—now—for the printed materials which are basic to the reconstruction of devastated areas and which can help to remove the intellectual blackout of Europe and the Orient.

There is need for a pooling of resources, for coordinated action in order that the devastated libraries of the world may be restocked as far as possible with needed American publications. The American Book Center War Devastated Libraries, Inc. has come into being to meet this need. It is a program that is born of the combined interests of library and educational organizations, of government agencies, and of many other official and non-official bodies in the United States.

The American Book Center is collecting and is shipping abroad scholarly books and periodicals which will be useful in research and necessary in the physical, economic, social and industrial rehabilitation and reconstruction of Europe and the Far East.

The Center cannot purchase books and periodicals; it must depend upon gifts from individuals, institutions, and organizations. Each state will be organized to participate in the program through the leadership of a state chairman. Other chairmen will organize interest in the principal subject fields. Cooperation with these leaders or direct individual contributions are welcomed.

What is Needed: Shipping facilities are precious and demand that all materials be carefully selected. Emphasis is placed upon publications issued during the past decade, upon scholarly books which are important contributions to their fields, upon periodicals (even incomplete volumes) of significance, upon fiction and non-fiction of distinction. All subjects —history, the social sciences, music, the arts, literature, and especially the sciences and technologies—are wanted.

How to Ship: All shipments should be sent PREPAID via the cheapest means of transportation to THE AMERICAN BOOK CENTER, % THE LIBRARY OF CONGRESS, WASHINGTON 25, D.C. Although the Center hopes that donors will assume the costs of transportation of their materials to Washington, when this is not possible reimbursement will be made upon notification by card or letter of the amount due. THE CENTER CANNOT ACCEPT MATERIAL WHICH IS SENT COLLECT. Reimbursement cannot be made for packing or other charges beyond actual transportation. When possible, periodicals should be tied together by volume. It will be helpful if missing issues are noted on incomplete volumes.

NEEDED: A Leitz 16mm. Apochromat Objective

A BPA member has asked the Secretary whether the above lens is obtainable new; or if used, in good condition. If you know of any for sale please write the Secretary, Miss Anne Shiras, Magee Hospital, Pittsburgh 13, Pa.

Association News

The Convention

The executive committee of the Chicago Chapter has announced the appointment of Ralph Creer as Program Chairman for the BPA convention to be meeting at the LaSalle Hotel, Chicago, September 5, 6, and 7. Mervin LaRue will be Chairman of the Technical Exhibits. Co-Chairmen of the Publicity Committee will be Dorothy Pinkham and Maria Elsasser. The Salon committee will be headed by Nat Horton and Charles Lindsey.

The 1946 Salon

The salon committee wishes to urge all the members to prepare their salon prints NOW. The salon always elicits discussions and information which cannot be gained in any other way. It affords an opportunity to present special photographic problems together with their solution. The prints in the salon supply valuable hints and stimulate others to achieve a higher standard of workmanship.

We hope you will cooperate to make this a comprehensive and outstanding representation of biological photography.

Send all correspondence and packages to:

Charles Lindsey
Loyola University School of Medicine
Photographic Department
706 S. Wollcott St.
Chicago 12, Ill.

VA Positions Open

The Medical Illustration Division in the Veterans Administration is providing positions for Clinical Photographers, Medical Artists and Statistical Draftsmen. These positions are under Federal Civil Service with starting salaries ranging from $1902 for clinical photographer trainees to $3640 for qualified clinical photographers and medical artists.

Interested workers in this field are invited to apply for these positions by submitting a completed Form No. 57 (obtainable from any U. S. Post Office) accompanied by samples of their work, wherever obtainable, to *Mr. C. Graham Eddy, Director, Medical Illustration, Veterans Administration, Washington 25, D. C. All samples of work submitted will be returned.*

Fellows of the BPA

With the passage of an enabling amendment at the 1945 annual meeting, the BPA moved closer to the creation of Fellowships in the Association. Fellowships are an attempt to fill the need for a well-deserved and stimulating advanced-classification for BPA members, based upon technical ability, high standards of photographic quality, and recognized service to the Association over an extended period.

Necessarily, not all these qualifications need be met in one individual; as, for example, in the case of a BPA member who is not a professional photographer, but whose service in a consultative and directive capacity has furthered the name and purposes of the BPA. Again, as will often be the case, all of the qualifications can and will be met in the same person.

At a meeting of the Board of Directors of the BPA held in New York City in February of this year, the first group of Fellows was created by the Board. Not all our members who are worthy of advanced classification by reason of their craftsmanship and accomplishments are included in this first group. A number remain to be recognized, we hope in the near future, by the annual elections provided for by constitutional amendment. Rather, the first group comprises the members who would already be Fellows had there been such a rank from the beginning; individuals whose continued active interest in the Association has helped to form and forward the BPA.

These individuals, then, by acclaim of the Directors, have earned the right to the title, Fellow of the Biological Photographic Association, and are privileged to use the letters FBPA after their names. The names of the Fellows will be announced at the annual meeting of the BPA in Chicago in September.

The Association for Scientific Photography and the Royal Photographic Society Merge

On February 22nd the Association for Scientific Photography held an Extraordinary General Meeting and voted by a majority of 92 to 6 to merge with the Royal Photographic Society. The Council of the Association advocated this step because it offered the following advantages:

1. The use of permanent headquarters for Meetings and Committees. 2. The participation in an established Journal, particularly Section B of the Photographic Journal, which is devoted to scientific applications of photography. 3. Access to a first-class library of photographic literature. 4. For a considerable proportion of members of the Association for Scientific Photography, one subscription would be payable instead of two.

The amalgamation became effective as of March 1, 1946. The Royal Photographic Society has a Scientific and Technical Group with which the members of the Association in the technical and industrial fields can merge. There has never been a Medical Group as a separate entity in the RPS, but one will now be formed so that the Association's Medical Group can continue to concentrate in its own field. This new group will have the right to appoint a representative to the Council of the RPS.

The Association for Scientific Photography was founded in November, 1942, and so has existed as a separate entity for four and one-half years. The Council, although convinced of the advantages to be gained by amalgamation, recognized the fact that the Association would lose its identity by such a step. An arrangement has been made whereby the Scientific and Technical Group Committee of the RPS will elect three nominated Members of the Council of ASP for one year; and half the Committee of the new Medical Group shall, for the first year, consist of members from the ASP Medical Group Committee. This transfer of Committee members should help to ensure continuity of policy in the ASP's special fields.

Meetings and Elections

The Association of Medical Illustrators. The meeting planned for June by the medical artists has been postponed until fall. It will probably be held in Philadelphia during the first week in September.

Boston Medical Photographers and Illustrators. Two combination meetings have been held in Boston, one at the Harvard Dental School and one at the Harvard Medical School. The meetings will be continued if the Program Committee can find material of interest to both medical artists and photographers. The following officers were elected at the first meeting:

Chairman ---------- Ferdinand Harding
Secretary-Treasurer ---------- Lawrence Brown
Program Committee ---------- Hugo Wellington, Miss M. Codding and Miss Piotti

Chicago Chapter of the BPA. The Chapter has held monthly meetings throughout the year, and has elected the following officers for 1946-47:

President ---------- Jay C. Garner, M.D.
Vice-President ---------- Charles Lindsay
Secretary ---------- Dorothy Pinkham
Treasurer ---------- Maria Elsasser
Board of Directors ---------- Tibor Benedek, M.D., Ralph Creer, George Reis

These elections were held at the February 20th meeting, and at that same meeting the Chapter regretfully said goodbye to Miss Avis Gregersen, former Chapter Secretary who left a few days later to join the Department of Dermatology at the University of Southern California of Medicine in Los Angeles. Dr. Garner referred to her most appropriately as the "spark-plug" of the Chicago Chapter. Without her tireless work the Chapter would never have grown into the active organization it now is.

The Pittsburgh Chapter. With its Chairman Al Levin overseas, the Pittsburgh Chapter remained in abeyance most of the winter of 1946. As soon as Mr. Levin came home, a meeting was called in April, at which he projected pictures showing the life and travels of an Army Medical Photographer in Italy and on Saipan. It is likely that the Chapter will begin an active program of meetings again next year.

H. Lou Gibson has been elected Section Chairman of Photography of the Rochester Academy of Science, N.Y.

News of Our Members in the MMAD

An Army Medical Illustration Service is still being maintained at the Medical Museum in Washington, but the various Medical Museum and Arts Detachments have disbanded. During their overseas service they amassed more than 100,000 medical prints, the largest collection of its kind in the world.

"Ralph Creer, who was in charge of organizing and training the units, has returned to Chicago. The following item about him appeared in the MILITARY SURGEON, March 9, 1946; "Major Ralph Creer, M.A.C., who for nearly four years has been in the Army Medical Museum in charge of the Medical Illustration Service of the Army, left the military service in January for similar work in new fields. He was to associate himself in February with the American Medical Association in connection with the Society's Motion Picture Program. Prior to Major Creer's departure for Chicago he was engaged in drafting a plan for a Medical Illustration Service for the Veterans' Administration and in consultations upon personnel for the service. Major Creer will retain connection with the Veterans' Administration as Senior Consultant of the service of medical illustration."

Major Graham Eddy, who was in command of the 1st Detachment, is now at the Veterans Administration in Washington, D.C. as Director of Medical Illustration. An announcement of the openings for medical photographers in the Illustration Division appears elsewhere in this Journal.

We are indebted to Frederic Stiner, of the Army Medical Museum's Illustration Service for news of a few more members. Peder Lund is with the Veterans Administration. Francis Howard has returned to Reading, Pa. Fred Beal has gone back to Cleveland, Ohio, as a medical photographer. Rowland Schnick is in the photographic department of the University of Maryland School of Medicine. Sydney Shapiro is in Brooklyn, N.Y. Albert Levin is in medical photography in Pittsburgh, Pa. Harold Baitz has returned to the American Optical Co., Spencer Instrument Division, in Buffalo, N.Y. Captain Charles Brownell, when we last heard, had returned to the states and was at the Army Medical Museum in Washington, D.C.

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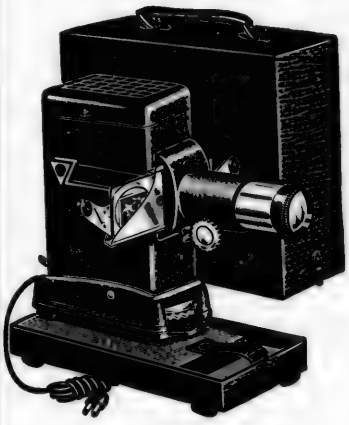

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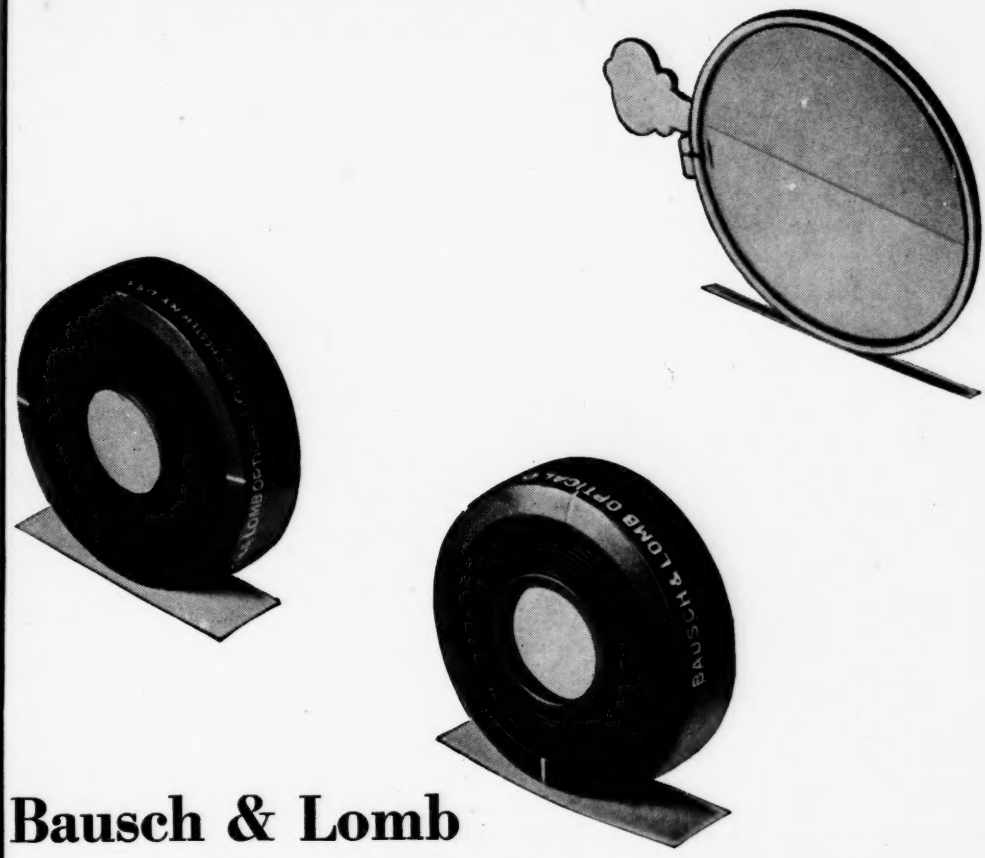

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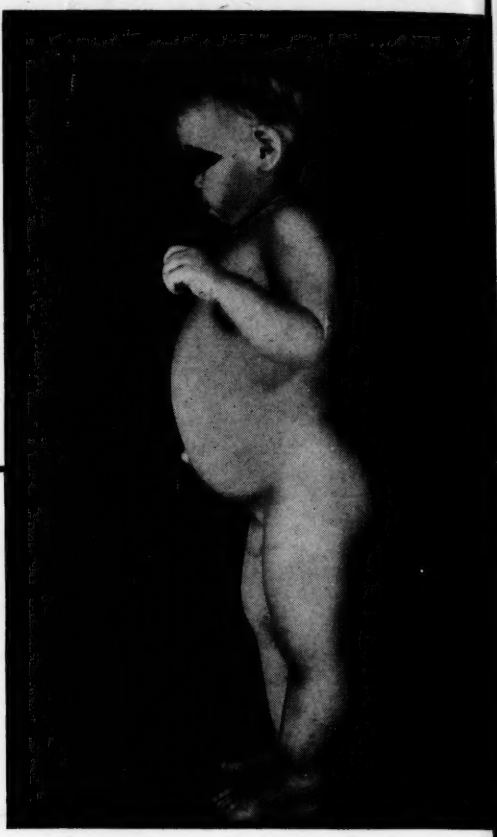

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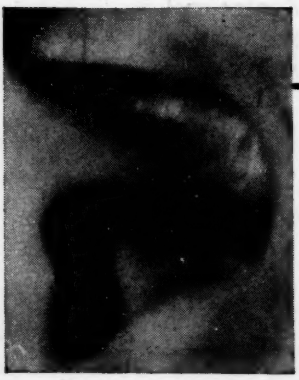

Extreme Left: Negligible graininess of Kodak Super Panchro-Press Film, Type B, is demonstrated by this 10× enlargement of original (section of ear).

Left: "Orthochromatic" rendition obtained by using Wratten Filter No. 66. Area shown is portion of buttocks.